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March 2019

DESIGN | INNOVATE | ENGINEER

Eureka!

THE FUTURE OF MOBILITY

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INNOVATIVE DESIGN



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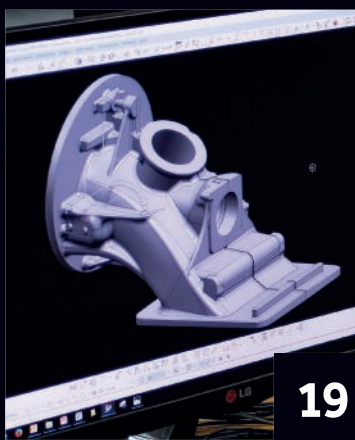
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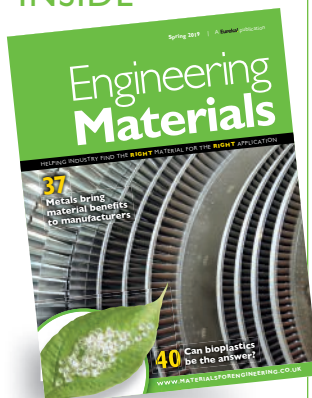
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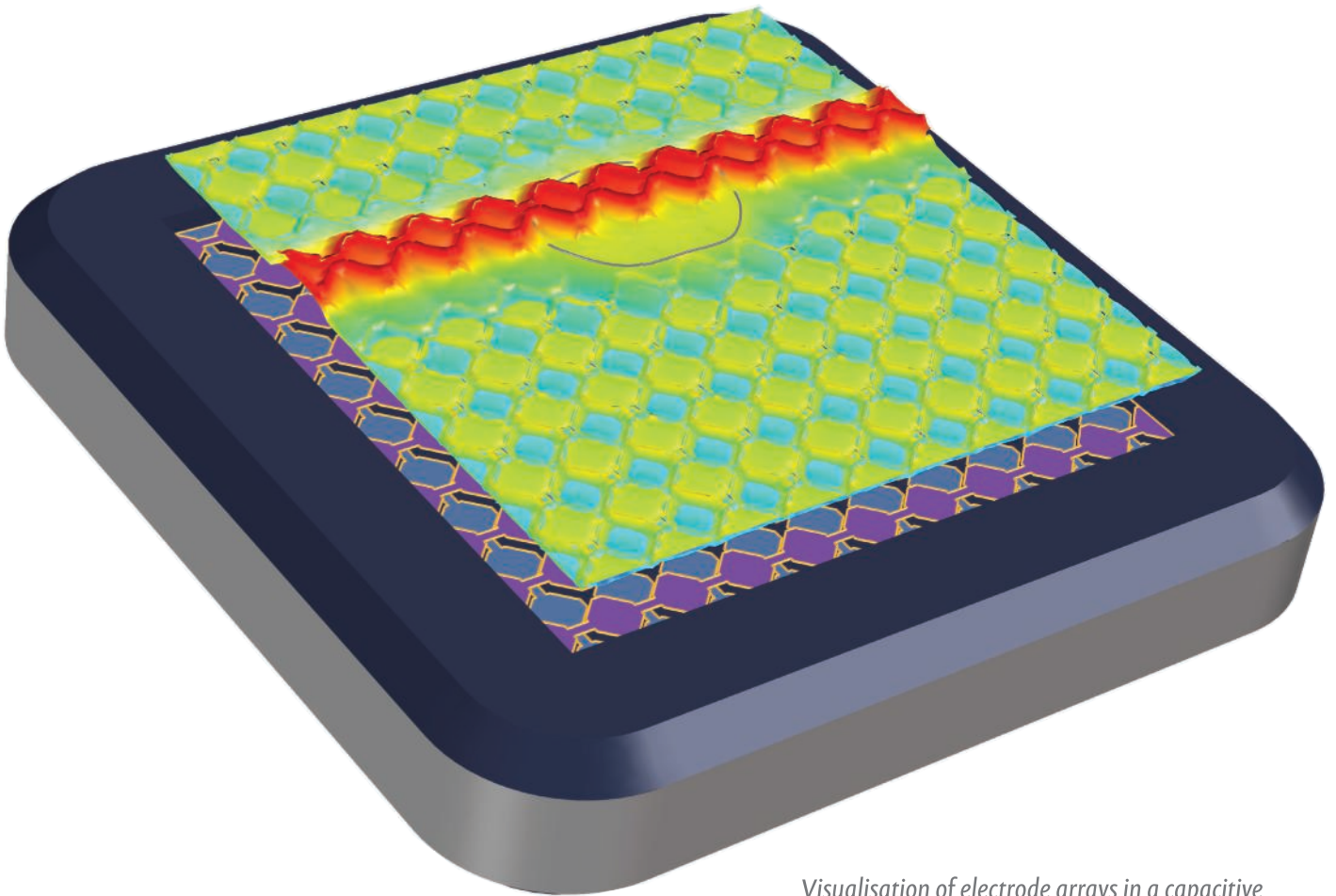
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This month's challenge is to design a bench that will always be dry despite rainy weather or lack of sun to evaporate puddles.

Design better touchscreens with simulation.



Visualisation of electrode arrays in a capacitive touchscreen sensor and the log of the electric field norm when a finger touches the screen.

Many touchscreens used in today's consumer electronics rely on capacitive sensing. Electrodes are embedded in a dielectric material, such as glass, and a voltage differential is applied, creating an electrostatic field. When someone touches the screen, the fields and capacitance change, and the device senses what part of the screen is being touched. To design better touchscreens, you can use simulation to accurately model the electrodes, surrounding metallic housing, and other dielectric objects.

The COMSOL Multiphysics® software is used for simulating designs, devices, and processes in all fields of engineering, manufacturing, and scientific research. See how you can apply it to analysing capacitive touchscreens in consumer electronics.

comsol.blog/touchscreens



AN INDUSTRIAL RENAISSANCE

SPEAKING AT THE group's Solidworks World Event in Dallas, Texas, Gian Paolo Bassi, CEO of Dassault Systemes' CEO Solidworks harked back to the 15th century and the invention of the printing press. He did this to illustrate just how fundamental the changes taking place in industry currently are and the consequent need for a completely new paradigm to cope with that.

These changes, he felt, were so complete as to need a new way of thinking and he termed the "very deep and lasting transition" that industry is currently experiencing "The Industrial Renaissance".

Quite how extreme the changes possible within this 'renaissance' may be were illustrated in other areas, with one of the more striking being highlighted by president and chief executive officer of Dassault Systèmes Bernard Charlès. This was an initiative by Ecco Shoes to create – in conjunction with Solidworks – bespoke shoes for customers on a mass scale within a two-hour turnaround time.

The technological challenges of such undertakings – and their potential implications for the future of industry and design – are profound. However, we are in a demand-led culture and it is this level of flexibility and adaptability that are going to shape the future for many of us.

Anyone doubting how fundamental the changes taking place within the design world are need only have looked as far as the event's Partner Pavilion, which featured an array of design engineering-associated technologies.

One of the most eye-catching of these was on the MakerBot stand in the form of



the company's latest technology offering, the MakerBot Method.

The Method represents the very real arrival of 3D printing as a mainstream technology. No longer for either low-end hobbyist or high-end manufacturers, it is designed to democratise the technology.

Things change fast in an industrial renaissance.

Paul Fanning, Editor

MISSION STATEMENT

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Eureka! connects design engineers with the UK's industrial heartbeat by providing in-depth coverage on the very latest technology developments and industry trends; keeping you inspired, informed and innovative.

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GPS inventors win QEPrize

THE ENGINEERS BEHIND

the development of GPS (the first global satellite-based positioning system) have won the 2019 Queen Elizabeth Prize for Engineering.

Announcing the winners of the £1m award, Lord Browne of Madingley, chairman of the Queen Elizabeth Prize for Engineering Foundation said: "Everything in the modern world, from transportation to banking, agriculture, medicine, the smart phone in our pockets – all of it relies on this technology. They've rewritten, in a major way, the infrastructure of our world."

Receiving the award at the Royal Academy of Engineering in London, programme director, Dr Bradford Parkinson said: "It's a recognition not just of the four of us but of scores of engineers that actually made it possible. It's a deep honour, I appreciate what



The winners of the 2019 QE Prize for engineering: Richard Schwartz, Dr Bradford Parkinson, Professor James Spilker and Hugo Fruehauf

you have done in recognising people who are virtually anonymous: engineers."

Dr Parkinson added that despite the technology's origins in the defence sector it was always envisaged that it would have a positive effect on the wider

civilian world. While the engineers couldn't have foreseen the full impact of the technology, early applications foreseen by the team included car navigation systems, and air traffic control, two areas which have been fundamentally transformed by GPS.



DEVELOPING 4WD POWERTRAINS

MILLBROOK HAS COMMISSIONED a full-vehicle 4WD powertrain test system which will help to reduce vehicle development times by streamlining powertrain integration and simulation.

Powertrains can be tested in any configuration, either with or without the full vehicle (Powertrain-In-the-Loop (PIL) or Vehicle-In-the-Loop (VIL)). This will reduce the number

of prototypes required, allow systems and components to be tested in parallel and enable Millbrook's customers to make more choices on how the integrated vehicle will function while working at component level.

The facility can simulate real-world and regulatory drive cycles and can accommodate vehicles ranging from a small city car to an SUV and is also suitable for

motorsport and light commercial vehicles.

Phil Stones, chief engineer – propulsion at Millbrook, said: "To develop our customers' products they need safe, reliable and efficient test equipment, knowledgeable support and innovative test solutions. By providing all these things, we are playing our part in the development of the most advanced vehicle technologies."



PRODUCTION OF A380 STOPS

AIRBUS IS TO cease production of the A380 after Emirates, the largest A380 customer, cut its order for the superjumbos from 162 to 123, as well as increased competition by smaller, more efficient aircraft.

Airbus said the last deliveries of the world's largest passenger aircraft, which cost about £19.4bn to develop, would be made in 2021.

Emirates said it would take delivery of 14 further A380s over the next two years but

has also ordered 70 of Airbus' smaller A330 and A350 models.

Airbus CEO Tom Enders said: "As a result of this decision we have no substantial A380 backlog and hence no basis to sustain production, despite all our sales efforts with other airlines in recent years."

Airbus said it will soon start discussions regarding the 3,000 to 3,500 positions potentially impacted by the announcement, including almost 200 in the UK, where

Airbus constructs wings for some of its models including the A380.

The company said it hopes to redeploy a "significant number" of affected staff to other projects, such as the A320.

The announcement came as Airbus revealed its full year results, which show an increase in consolidated revenues to €63.7bn, which were driven largely by deliveries of commercial aircraft.

TECH BRIEF

IMPROVED HANDLING FOR LARGE CAD MODELS

THE LATEST VERSION of CoreTechnologie's 3D_Evolution Simplifier features a 'balloon' function that is said to fully automate the selection of interior or exterior parts. The tool can be used for digital mock-up and VR applications and is designed to simplify large assemblies of cars, trucks, planes and trains.

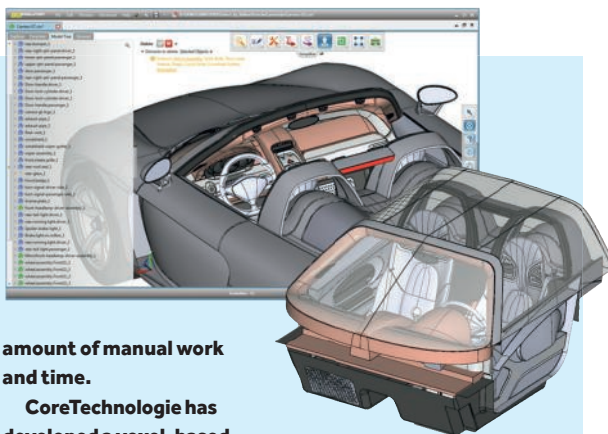
In extremely large assemblies, the selection of the desired components or sub-assemblies can be difficult and takes a large

amount of manual work and time.

CoreTechnologie has developed a voxel-based function for 3D_Evolution Simplifier that selects the desired items through a 'balloon' stretching out from a user defined starting point. The automatically selected models, which represent either the interior or exterior, can be converted to all common 3D formats.

The company said: "When collaborating with suppliers, customers or partners, as well as in

downstream processes, automatic selection and envelope geometry generation of complex components is an integral part of the PLM process chain, both for the protection of know-how and for the automated creation of lightweight 3D models used for VR and DMU process or for further operations in the CAD system."



Highest flow on the coupling market



Safety has been **CEJN's** top priority for many years, which led them to develop eSafe: a compact one hand operated, high flow coupling that vents downstream air before disconnection, eliminating the risk of hose whip.

eSafe is an innovative and patented safety coupling offering the highest flow on the coupling market, combined with a low pressure drop. A low connecting force and easy to grip design makes eSafe the natural choice when choosing a safety product with top of the line features. Contact Tom Parker Ltd for more information on the eSafe range.



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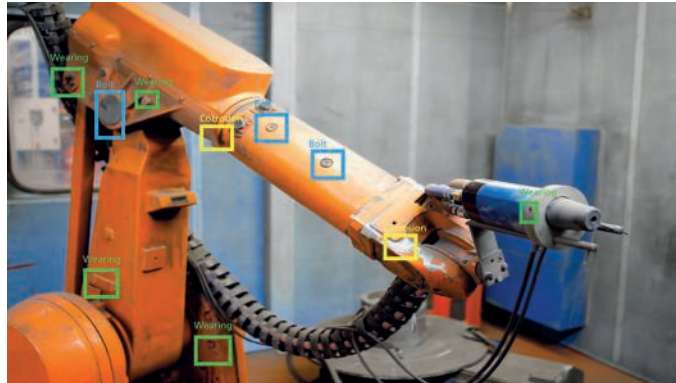
ELECTRIC TRANSPORT RESEARCH

THE WOLFSON FOUNDATION has donated £1.5m to fund state-of-the-art equipment that will advance research into sustainable, electric transport at the University of Nottingham.

The Wolfson Foundation's chief executive, Paul Ramsbottom, said: "The Wolfson Foundation funds research infrastructure underpinning international quality research."

The Aerospace and Electric Flight Test Cell Propulsion Unit will be located in the 3,500m² Power Electronics and Machines Centre research facility, which is due to open in summer 2020.

Ramsbottom added: "The new facility will also enable us to work even more closely with our industrial partners on research, particularly those companies working in the electrification of future transport systems."



AI key to inspections

REPRESENTATIVES FROM ACROSS the automotive, aerospace and engineering industries have called for the widespread use of artificial intelligence (AI) technology during the industrial inspection process to help overcome the challenges associated with manual inspection.

Speaking at the Artificial Intelligence for Industrial Inspection (AI4II) event, they highlighted the need to replace manual inspection of high value components with automated technology.

Oliver Grellou, non-destructive and mechanical testing engineer at Airbus, said: "Manual inspections of a wing, for example,

can often be dangerous for our engineers. Introducing smarter evaluation of these components with automated technology will be revolutionary for us and we hope to roll out this technology across our production processes in 2019."

The panel discussed AI-based technology as a means of overcoming high labour costs, human error and health and safety concerns – all largely associated with the need to speed up the inspection process in line with growing demand for high quality machinery that lasts.

Dr Iris Fermin, innovation lead engineer at JLR, said: "Our aim for the future would be that quality of cars can be checked solely by autonomous technology."



MOVERS & SHAKERS

WAYNE BURGESS TO LEAD GEELY DESIGN UK

Geely Auto Group has announced that leading British designer Wayne Burgess will be joining Geely Design, the Group's global network of design studios. Burgess will join the newly established Geely Design UK as head of design and vice president.

PROF MARTIN GILLIE JOINS NMITE

The New Model in Technology & Engineering (NMITE), the project to create the engineering university of the future in Hereford, has appointed Professor Martin Gillie as its provost and chief academic officer. Professor Gillie will be taking the lead on all academic matters. The role was previously undertaken by NMITE's CEO, Professor Elena Rodriguez-Falcon.

NEW VP FOR BUEHLER

Julien Noel has been named vice president/general manager of the Buehler worldwide division. Buehler is a manufacturer of scientific equipment, consumables and accessories.

NEW CEO AT TECHNOLOGY ENABLER

Würth Elektronik eiSos has appointed Thomas Wild as its new CEO. Wild will continue to be responsible for finance, controlling, reporting and administration. He has been with Würth Group since 2001 and since 2009 as CFO of the Würth Elektronik eiSos.

TECH BRIEF

DASSAULT SYSTÈMES INTRODUCES 3DEXPERIENCE.WORKS

At the SOLIDWORKS World conference in Dallas, Texas, Dassault Systèmes unveiled 3DEXPERIENCE.WORKS, a portfolio of industry-aware applications on the 3DEXPERIENCE platform that it said is tailored to the needs of small and midsize companies.

3DEXPERIENCE.WORKS is claimed to combine social collaboration with design,

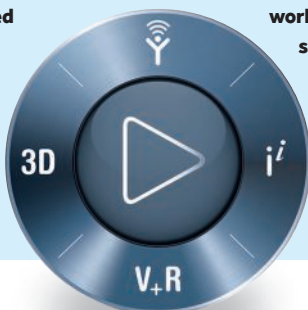
simulation and manufacturing ERP capabilities in a single digital environment to help growing businesses become more inventive, efficient and responsive.

Bernard Charlès, vice chairman and CEO, Dassault Systèmes, said:

"Small and midsize firms worldwide need digital solutions to grow but have long been challenged to find ones that are right for their size. By introducing

3DEXPERIENCE.WORKS, we bring the platform effect to them.

"The 3DEXPERIENCE.WORKS family now includes DELMIWORKS to serve mainstream manufacturers by providing a full digital thread for business operations. The 3DEXPERIENCE platform is poised to become the benchmark for business operations in this category of firms through well integrated offerings spanning manufacturing and management that are simple, affordable and easy to implement."





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Many of our parts are unique and designed to order in short lead time, so we do not have the luxury of physical prototyping. Investing in SOLIDWORKS has proven to be an excellent decision, it is reliable, flexible and easy to deploy and administrate.

Tim Cutler

Engineering Systems
Manager
Ishida Europe Ltd.



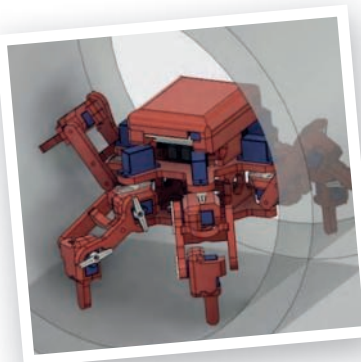
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MINI ROBOTS TO INSPECT PIPE NETWORK

MINIATURE ROBOTS COULD be used to repair underground pipes, reducing the need for costly roadworks, as part of government-funded research.

Researchers from four British universities are collaborating to develop 1cm long devices that use sensors, navigation and communication systems to detect, report and mend cracks and leaks in water, gas and sewage pipes.

Resolving issues this early on will reduce the cost of intervention and associated disruption. Professor Kirill Horoshenkov from the University of Sheffield leads a team that will receive the £7.2 million research grant from the UK's Engineering and Physical Sciences Research Council to carry out this research programme in collaboration with the Universities of Birmingham, Bristol and Leeds.



Revolutionising manufacturing

AN AUTOMATED, SELF-CONTAINED miniature factory, developed by the Universities of Birmingham and Loughborough in partnership with the Manufacturing Technology Centre, is set to help SMEs access the next generation of manufacturing techniques.

The University of Birmingham's Professor Martin Freer, said: "Factory in a Box is an exciting opportunity for small companies to rapidly transition from technology developer to providing a product stream to market."

The Factory in a Box (FIAB) initiative provides intelligent

factories that can be distributed, linked and centrally controlled. Contained within a unit the size of a shipping container, the factories are quickly deployable, flexible to use and can be rapidly scaled. They are fully digital and can be linked to a central control centre with remote monitoring and predictive maintenance capability.

These methods have the potential to revolutionise the way manufacturing is done, providing state-of-the-art manufacturing, but also connecting intelligently to the supply chain and customer to optimise production.



BUSINESS NEWS

COBOT MAKER DOUBLES IN SIZE

Reeco Automation has doubled the number of staff employed at its Mid-Wales headquarters in the last year and is planning further recruitment over the coming months. The company has secured several high-profile customers including Ford, Rolls Royce, Honeywell and, most recently, Unilever.

PEARSON HYDRAULICS BUYS P & R HYDRAULICS

The directors of Pearson Hydraulics have announced the acquisition of P & R Hydraulics which will expand the company's product range and services. The new company will strengthen the team to over 45 employees and bring in additional skills.

TRACE SELLS CAD SOFTWARE TO DASSAULT

Trace Software International has sold its elecworks, electrical CAD software for the design of electrical and automation projects, to Dassault Systèmes Solidworks. Trace has committed to refocussing on the development of software for the electrical calculation and photovoltaic industries.

ROCKWELL AUTOMATION ACQUIRES EMULATE3D

Rockwell Automation has acquired Emulate3D, an engineering software developer whose software enables customers to virtually test machine and system designs before incurring manufacturing and automation costs.



SOLUTION TO LAST MONTH'S COFFEE TIME CHALLENGE

Our solution to design a truly effective means of propping up an electronic tablet that can be used anywhere and allow easy and adjustable viewing is called Tablift.

Tablift is specifically designed to address the problem of using your iPad or tablet in places like bed and the couch, where most use takes place. The Tablift allows you to use your tablet in places with uneven surfaces completely hands-free, giving you the freedom to sit or lie back and enjoy your tablet without having to hold



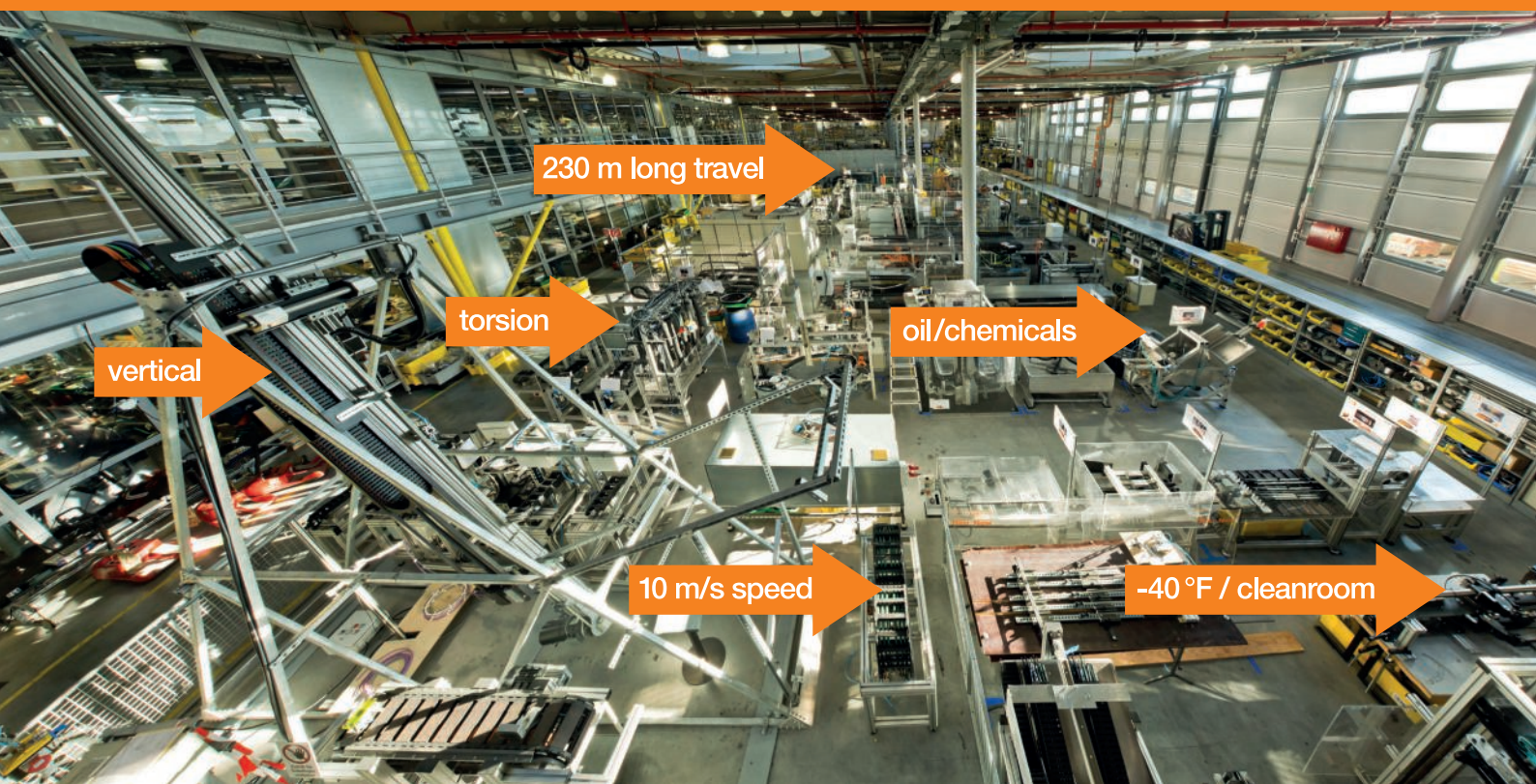
it in your hands or rest it on your lap. So now you can watch movies, read, check your email, and play games in complete comfort by freeing your hands.

The Tablift features an adjustable restraining strap that holds the tablet into the base of the Tablift, adjusts to any tablet, large or small. At the same time, 10mm grooves at the base will hold any tablet that is less than 10mm near the edge, which includes virtually all modern tablets made by all major tablet manufacturers.

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THE FUTURE OF MOBILITY

A highly prestigious design competition has the potential to revolutionise the lives of those suffering from lower limb disability.

One of the many benefits to have accrued from advances in electro-mechanical engineering in recent years has been a quantum leap in the quality and sophistication of devices designed to aid mobility and functionality for those with disabilities. One of the most striking areas where this has been apparent has been in prosthetics, where until recently, the technologies had remained largely unchanged for hundreds of years, only to be transformed in terms of functionality effectively within the space of a decade.

This is very much a model that those pursuing similar advances in mobility are hoping to emulate. Increasingly, the issue of mobility is coming to the fore, with greater financial and intellectual investment in it.

One recent high-profile example of this was the unveiling at the Consumer Electronics Show in Las Vegas of the five finalists in the three-year Mobility Unlimited Challenge.

The Toyota Mobility Foundation launched this \$4 million global challenge in 2017 in partnership with Nesta's Challenge Prize Centre, with the aim of improving the lives of millions of people with lower-limb paralysis.

Around the world, millions of people are living with lower-limb paralysis (the most common causes being strokes, spinal cord injury and multiple sclerosis). While there are no statistics on paralysis worldwide, the World Health Organization estimates there are 250,000-500,000 new cases of spinal cord injury globally every year.

Charlotte Macken of Nesta's



Challenge Prize Centre said: "Current personal mobility devices are often unable to fully meet the needs of users due to limitations affecting functionality and usability. Historically, the pace of innovation is slow, due to small and fragmented markets and difficulties in getting new technology funded by health-care systems and insurers. This can make the field unattractive to the very people who could help change the world. We hope that challenges like this can inspire innovation and are excited to see how the five finalists use this opportunity to develop their ideas further."

The Challenge invited engineers, innovators, and designers from across

Entries for the competition have come from around the world





the world to submit designs for game-changing technologies, incorporating intelligent systems, to improve the mobility and independence of people with lower-limb paralysis. Central to the Challenge is the importance of collaboration with end-users to develop devices that will integrate seamlessly into users' lives and environments, while being comfortable and easy to use, enabling greater independence and increased participation in daily life.

Devices range from a hybrid exoskeleton on wheels, to a powered wheelchair share scheme. Each finalist will receive a \$500,000 grant to develop their idea further and the final winner will be awarded \$1 million in 2020 in Tokyo.

The UK finalist is the Phoenix AI Ultralight Wheelchair, which is designed to be a manual wheelchair made from carbon-fibre that will use smart sensors to configure itself to what the user does. It will allow the wheelchair to remain in sync with how the user moves, with sensors detecting if the user is leaning forward or back and algorithms calculating the wheelchair's response.

INTELLIGENT CENTRE

According to Phoenix Instant, the wheelchair will include a number of smart functions yet to have been incorporated into wheelchair design, including an intelligent centre of gravity that will allow the device to continually adjust its centre of gravity to fit what the user does.

The team says it will make for a chair that is easier to push and turn by eliminating drag and uncomfortable, painful vibration whilst also making the chair safe from falling backwards. A lightweight power assist feature will also help users navigate slopes easier and an automatic braking system will remove the need for users to grip the wheels to slow down.

No stranger to carbon-fibre wheelchairs, accomplished product designer Andrew Slorance, Director of Phoenix Instinct, has had his designed exhibited in the London Design Museum and created products sold worldwide. »

The UK finalist is the Phoenix AI Ultralight Wheelchair, which is designed to be a manual wheelchair made from carbon-fibre that will use smart sensors to configure itself to what the user does

» As with the example of the prosthetic limbs, Slorance feels that the central technology of the wheelchair is long out of date and overdue an update.

While conceding that the wheelchair has proved itself as the most viable mobility device for decades has done well in that capacity, he now believes it is “tired” and “in need of a serious makeover”. The intention of this design, therefore, was to show how he believes that the wheelchair can be evolved while maintaining the core, proven fundamental capabilities that are behind its success as a mobility device.

Slorance wanted to be part of this Challenge because he broke his back aged 14 (he is 49 now). By the time he was 16, he'd decided that I would one day design a wheelchair that would change perceptions by using cutting-edge materials and styling.

He knew the next step beyond advanced materials has to be to make wheelchairs smart. But that costs a huge amount of money in development. So, when he saw this Challenge, he saw the opportunity to raise the money necessary to develop this technology.

This he felt was crucial since, without this impetus, he believed no-one else was going to do it. No company is going to decide to spend half a million dollars on research and development to advance the manual wheelchair as long as their competitor also doesn't do it the status quo can continue with wheelchairs remaining much as they were thirty-five years ago.

This Challenge changes that. But now, of course, is where the work really begins. The competitors have got eighteen months to turn the wheelchair which has been in the technological dark for so long into a futuristic device that intelligently makes wheelchair life easier.

EVOWALK

But the competition is stiff. Other entries include the Evowalk from Evolution Devices in the United States. This is a non-intrusive sleeve which goes around the user's leg and has sensors that track walking motion and stimulate the right muscles at the right time to improve mobility. This

particular type of muscle stimulation, it is believed, will also rehabilitate muscles over time.

According to the team, the device offers personalised, timed muscle stimulation that allows its users to contract their muscles as they walk. This contraction will not only assist users on a day-to-day basis, according to Evolution Devices, but also rehabilitate the muscles and neural pathways over time.

Pierluigi Mantovani from Evolution Devices said: “Mobility Unlimited Challenge is a fantastic opportunity for people to build devices that are normally hard to fund but could make a huge difference. This support will help us finish our research and develop the device further, so we can get it to the people who really need it. People like my dad.

“My dad has multiple sclerosis and developed foot drop. He was recommended a device that was far too expensive so myself and some friends built this prototype that helped. After that, we wanted to make something affordable for others. Our main goal has always been to help people regain the ability to walk freely again.”

Moby, from Italdesign in Italy is the first mobility service created for wheelchair users, operating like a cycle share scheme in urban hubs. Offering a series of wheel-on electric devices, it will make travelling around cities much simpler and easier for people with lightweight manual wheelchairs.

The service is accessible via an app-based share scheme. This allows users of the platform to interact with other wheelchair users, the device itself, as well as other means of transport.

Serena De Mori from Italdesign said: “Moby is a concept we developed over time, working with users of wheelchairs. They said they wanted a way to make travelling easier and so we developed this platform.

“We entered this Challenge because we wanted to have a different kind of mobility solution which is accessible to all. We are very happy

A total of 80 entries were received from 28 countries and the finalists were chosen by a panel of expert judges including, from the UK, Sophie Morgan, television presenter and disability advocate

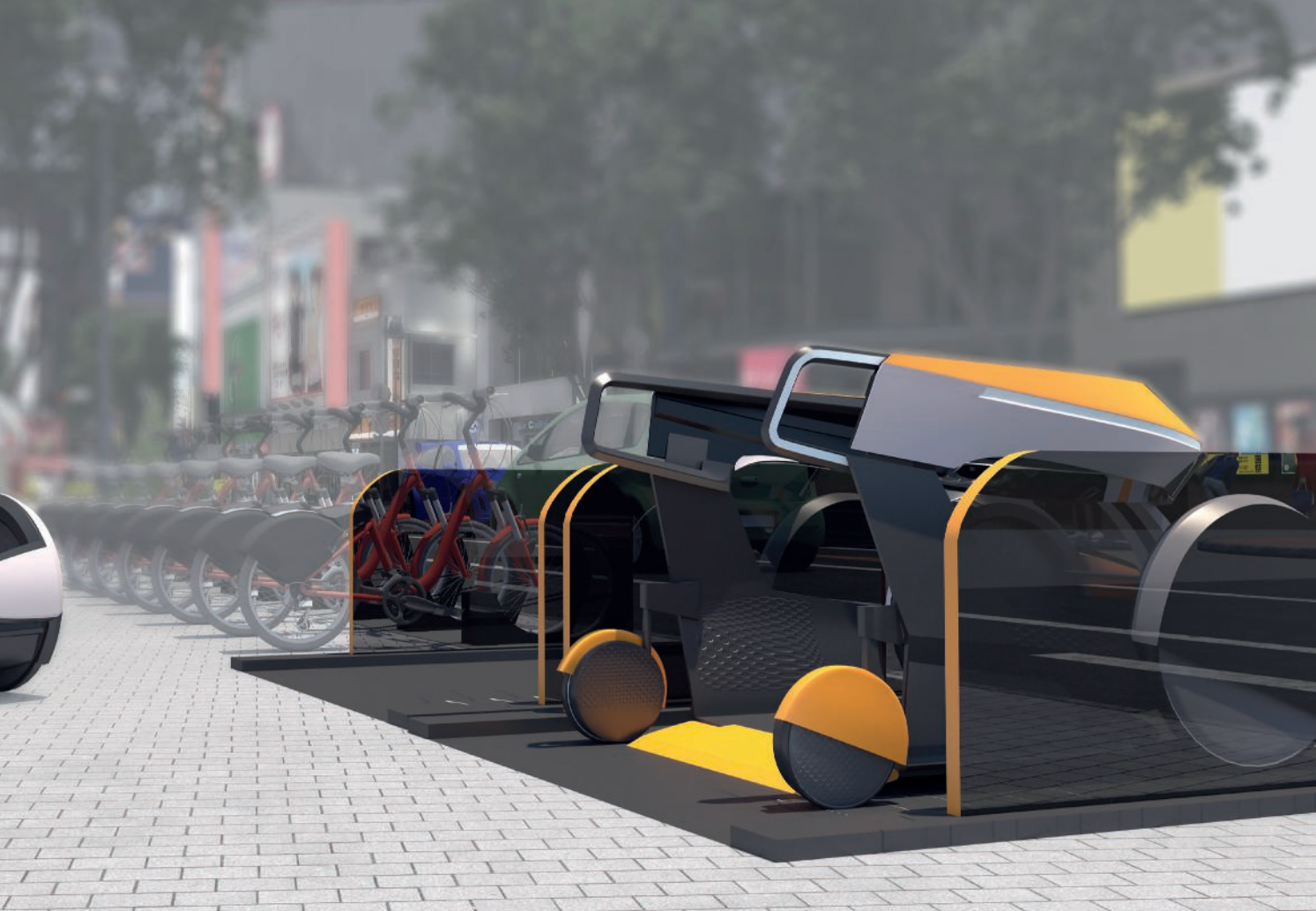


to have been selected for the Challenge and hope to develop the concept further and to build the first prototypes to test on the street as soon as possible.”

Qolo (Quality of Life with Locomotion) comes from Team Qolo, University of Tsukuba, Japan. This is a mobile exoskeleton on wheels that helps users to sit or stand with ease, effectively removing the ‘chair’ from ‘wheelchair’. Mobility is controlled using the upper body, allowing hands-free operation. The device enables users to travel around in a standing position, changing both physiological and social aspects of everyday living.

The QOLO Standing Device consists of a lightweight, mobile exoskeleton on wheels which uses passive actuators to allow users to sit or stand, effectively removing the ‘chair’ from ‘wheelchair’.

Users operate the device using their upper body, enabling people to keep their hands free, whilst the device allows the user to travel in a standing position. The ability to regain upright mobility changes both the physiological and social aspects of everyday living for those with lower limb paralysis says the team.



Quix, IHMC & Myolin (United States): a highly mobile, powered exoskeleton offering fast, stable and agile upright mobility, Quix uses modular actuation, perception technology from autonomous vehicles and control algorithms for balancing autonomous humanoid robots to deliver the mobility, safety and independence that current exoskeletons cannot provide.

The team says the exoskeleton is able to provide the mobility, safety and independence current exoskeletons on the market are unable to via modular actuation, perception technology from autonomous vehicles and control algorithms for balancing autonomous humanoid robots.

DEVELOPING TECH

Peter Neuhaus from IHMC & Myolin said: "In the business world, developing technologies for people with lower-limb paralysis has been extraordinarily hard. We've constantly struggled against people saying the market is too small and because of that people aren't putting in the effort, research or investment this field deserves, meaning there hasn't been enough advancement.

A total of 80 entries were received



The Phoenix Ultralight AI wheelchair from the UK

from 28 countries and the finalists were chosen by a panel of expert judges including, from the UK, Sophie Morgan, television presenter and disability advocate, and Ruth Peachment, Occupational Therapy Clinical Specialist at the National Spinal Injuries Centre.

Dr. Eric Krotkov, chief science officer at the Toyota Research Institute

and one of the Challenge judges, said: "There are so many technological opportunities to explore approaches to alleviate challenges stemming from lower-limb paralysis. A competition like the Mobility Unlimited Challenge gets innovators to focus on the same problem to identify something of great common interest that serves society. I am excited by these finalists who have a breadth of technical approaches such as wheelchairs, orthotics, braces and exoskeletons. I look forward to seeing how they will take these devices out of their conceptual stage to help our end users."

Ryan Klem, director of programs for the Toyota Mobility Foundation commented: "These five finalists have shown real innovation driven by human-centred design. We think that the technology incorporated in these devices could change the lives of a huge number of people around the world, not just for those with lower-limb paralysis, but also those with a wider range of mobility needs. It will be fascinating to follow the teams' journeys and see how the \$500,000 grant will help them develop their ideas to bring them to market and into the hands of users." 

ELECTRIFICATION FROM THE TRACK TO THE WORLD

On the first anniversary of ABB's involvement as the title sponsor of Formula E, Tom Austin-Morgan sat down with its European president Frank Duggan to see how the partnership could affect the wider world.

In January 2018 ABB became the first ever title sponsor of an FIA (Fédération Internationale de l'Automobile) motorsport series when it partnered with the all-electric racing series Formula E. This caused a bit of confusion for the average – or even most knowledgeable – motorsport fan as those outside of industrial circles hadn't really heard of the Swiss group, let alone what it did.

Duggan fully admits that the company's brand recognition in the wider world isn't strong: "ABB is the least known in our industry, people think of GE and Siemens, even though we're the biggest in our specific sector.

"I think also, ABB has been traditionally the engineer's engineering company. We really worked on developing a lot of technology, and technology was what the users came to associate with ABB. Brand recognition is really important and it's something that we have only really come to do in recent years."

Duggan certainly isn't wrong, ABB is a huge multinational that may only have been formed in 1988, but this came as the result of the merger of electrical light and generator company Allmänna Svenska Elektriska Aktiebolaget (General Swedish Electrical Limited Company, ASEA) and Switzerland-based Brown, Boveri & Cie (BBC) which produced AC and DC motors generators, steam turbines and transformers. ASEA had been trading since 1883 and BBC was formed in 1891, so there's a lot of history in electrification within the DNA of ABB.



Though the company faced bankruptcy in the early 2000s, the business has since recovered and further expanded into robotics and motion, industrial automation and had a power grids division that was bought by Hitachi in December 2018. ABB now employs around 147,000 people globally and posted a net income of \$2.2 billion in 2017. Latterly, it has begun to get into the electrification and fast charging of vehicles.

Duggan adds: "We were the first to develop the fast DC charger and today we have almost 9,000 fast DC chargers in the market. Slow AC charging is good for offices or at home but to really make electric vehicle transportation viable over long distances you must have fast charging.

"The latest fast charger we have can charge a car for 200km in eight minutes, 400km in 16 minutes. That makes charging on highways viable."

Right now, fast DC charging is too powerful for most consumer vehicles, which is why you've probably never seen an ABB fast DC charger in

the wild. But all that may be about to change. The first consumer car capable of taking this power will be Porsche's Taycan, which is due to be released later in 2019.

This shows that the batteries and other technologies are finally catching up to industrial capability, which Duggan says is going to change the landscape with regards to electric vehicle charging stations and the number of EVs on the roads. It also sheds some light as to why ABB has become involved with Formula E.

"If you look at road vehicles, trucks and buses particularly, the powertrain is part of the technology that's converting the power into torque and mechanical power," Duggan explains. "We are one of the biggest suppliers of variable speed industrial motors and drives for pumps, fans and air-conditioning. The powertrain in a car is very similar to an industrial powertrain.

"So, from the generation of power through the transmission and distribution of smart power to the



"THE LATEST FAST CHARGER WE HAVE CAN CHARGE A CAR FOR 200KM IN EIGHT MINUTES"

Frank Duggan



"We are one of the biggest suppliers of variable speed industrial motors and drives for pumps, fans and air-conditioning. The powertrain in a car is very similar to an industrial powertrain"

usage from the vehicle, ABB has many, many touchpoints. Combining that with getting brand recognition was an obvious choice for us. And the FIA really wanted a technology partner to become the title sponsor."

He goes on to clarify that ABB will always be a Tier 2 supplier and will never go into vehicle manufacturing, but he hopes the powertrains used in future electric vehicles will be made by ABB.

As a sponsor of the Solar Impulse project to fly an aeroplane around the world using only solar power, ABB has some experience when it comes to cutting edge electrification projects. The energy efficiency, power output and energy storage findings from that project directly correspond to the electric racing cars in Formula E.

But, as ever with motorsport, things can take a while to get started. After a full year of sponsorship there hasn't been a lot of flow of information back

and forth yet. According to Duggan, this is mainly to do with the fact that the second-generation cars had already been designed before ABB's sponsorship was signed. However, he says ABB will have much more involvement with the development of the 'Gen3' cars, which could come as soon as 2020.

"We joined Formula E a year ago and now we'll start working with the teams on future technology; how to get more out of the car through the powertrain efficiency," he says.

What ABB has managed to do in the last year is set up a think tank for all stakeholders in electric mobility: car manufacturers; utilities providers; and battery manufacturers to look at specifications, norms, and standards.

Duggan says: "If you look at UPS, for example, in the States they have almost 250,000 vehicles. Imagine if they made all their vehicles electric. First, the emissions that would be

saved. But then, counter to that, all their depots and the networks to feed them would have to have much more robust electrical solutions. How do you do that? When is the best time to charge? All of this is part of developing a new industry."

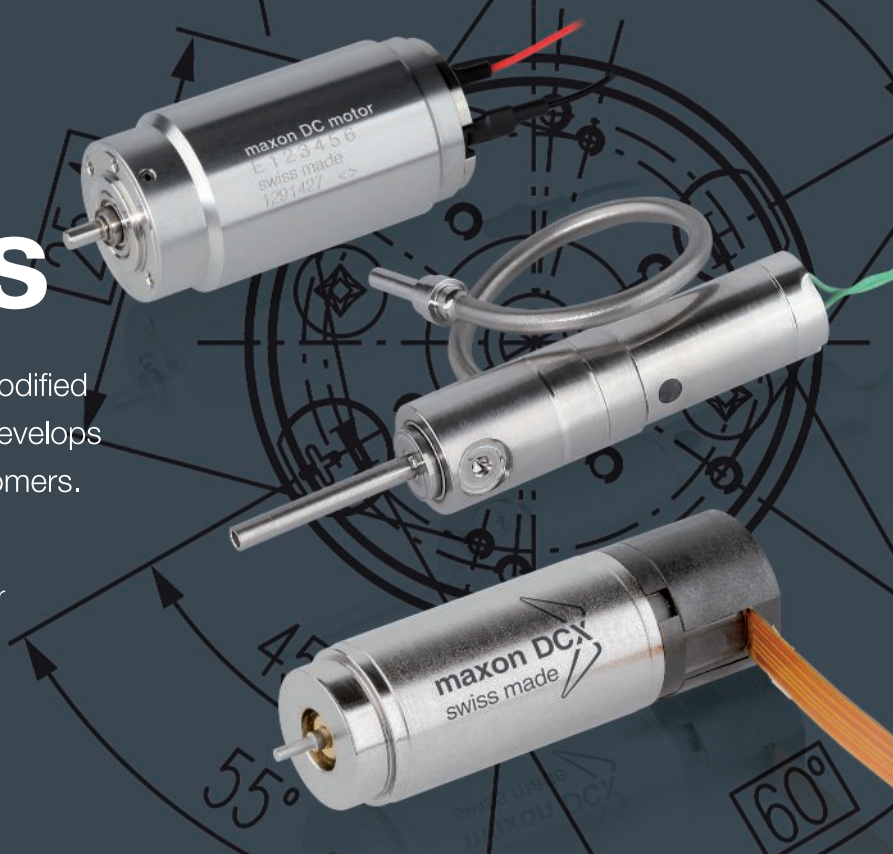
Almost more than getting involved in the development of electric race cars, ABB is positioning itself at the head of the coming electrification revolution. One that has the potential to seriously impact the effects of climate change and herald the end of fossil-fuel-powered transportation in as little as 12 years (roughly the lifetime of two car models).

"Renewables help us to make a more sustainable world," Duggan says. "We have to think of the next generation and the generation after that. So, despite what certain presidents of certain countries think about the world and emissions, I do think generally it's accepted that we need to really look at carbon emissions when say we want to keep a sustainable world." **1**

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MISSION IMPOSSIBLE?

Two teams of designers and engineers operating 12 time zones apart worked collaboratively to produce sand casted parts for a new waterjet boat propulsion system in just 10 weeks. Tom Austin-Morgan finds out how it was done.

Founded 78 years ago, New Zealand-based Hamilton Jet developed the first waterjet propulsion system for boats and other vessels. Today, the Hamilton Waterjet range includes models with power ranges from 150 to 500kW that are used by vessels typically up to 80 metres in length, including patrol boats, fast ferries, offshore crew boats, fire boats, fishing vessels, recreational and military craft.

However, despite the company's long history in its market, there are some projects where collaboration is required. Such was the case with the launch of its HTX30 model. Hamilton Jet needed a cowling to encase a working prototype, built from scratch within 10 weeks to display at an upcoming exhibition, Seawork in Southampton.

British casting, engineering and manufacturing company Grainger & Worrall had worked with Hamilton Jet's CEO, Ben Reed, previously. He judged the company to be a good match for the project and asked it to create the parts using its S-max cold cure sand casting technique.

Edward Grainger, managing director – prototype at Grainger & Worrall, says: "We're a similar

business inasmuch as we have been around for 70-odd years, we've come together on this project and supported [Hamilton Jet] to get something that's quite unique on the market really quickly.

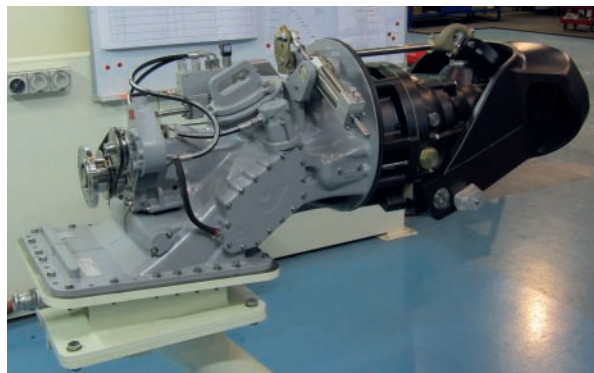
"We made them a very lightweight, nimble but robust cowling comprising four main pieces to house the high-powered engine unit. It will be under quite a lot of strain and stresses in a harsh salt water environment."

To get this done in time, the team at Grainger & Worrall needed to work to strict deadlines with their designs finished and uploaded to



Above: Edward Grainger managing director - prototype at Grainger & Worrall

Below: The HTX30 Waterjet



the servers at the end of the night so the Hamilton Jet team could begin working on them straight away in the morning. With New Zealand being 12 hours ahead, this created an effective 24-hour working day that Grainger says was 'really proactive' but required them to be 'very positive and organised'.

"The first challenge was that they had a very short lead time and opportunity to bring this to market," Grainger explains. "They wanted to hit a particular show and particular opportunities in the marketplace to get their product out there.

"So, our challenge was to deliver something very quickly, but something that would also be representative of what would be produced downstream in series production [by Hamilton Jet]." Sand casting was the method chosen because, Grainger says, it is best suited to low volume production as well as offering more design flexibility, the ability to choose where and how to fill the casting and how it solidifies can all be tweaked to create the best quality casts. »

» A high silicon, high-purity marine grade alloy, confers certain challenges to the caster, especially given the size of the parts. This requires precise engineering of the casting process to meet the performance requirement for the application.

"Ten weeks from the go-ahead to delivering a finished machined part is quite quick, when you consider that we printed moulds that were in the region of 1.8 x 1.3 x 1.3m. Three tons of printed sand went into producing just one of the larger parts. Applying digital manufacturing technologies on that scale, and against that sort of time pressure is probably the biggest feat in this whole project."

The Grainger & Worrall team used MAGMA software to simulate the casting process from the filling and solidification of the alloy to predicting the mechanical properties of the final cast part in order to prevent defects and therefore the risk of part failure which would cost money and, more valuably on this project, time. The later in the process these changes are implemented, the costlier they get.

"Hamilton Jets' design was quite mature and their expectations of their designs and specifications were quite challenging but also quite realistic," says Grainger. "Nonetheless, we'd received their 3D data, we'd make some recommendations for manufacture, including the moulding, the casting, the post-processing of the parts, the machining of the parts



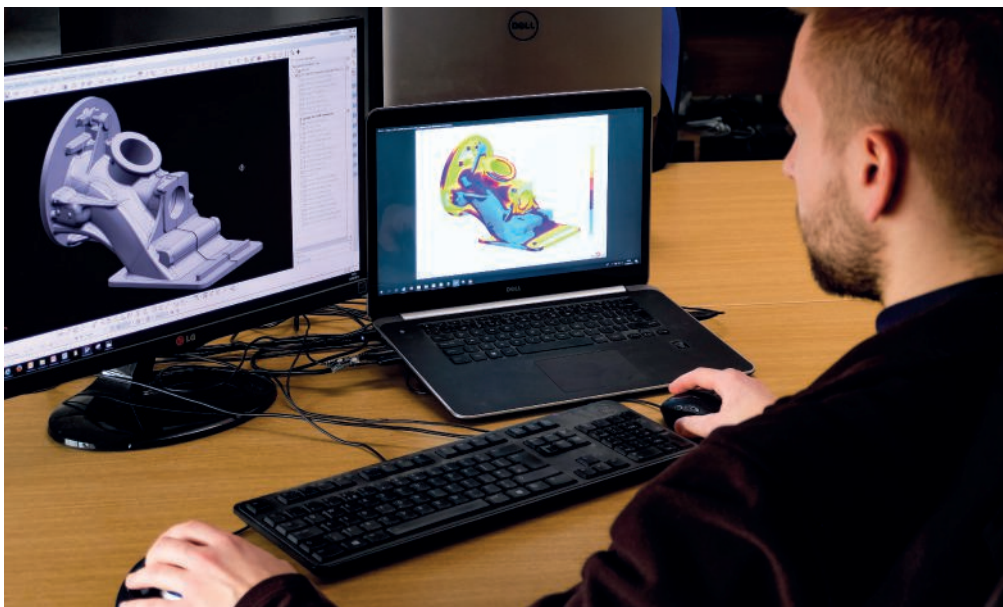
and assembly. They would consider them, and we would work those through together."

The parts were validated against the original CAD models via CT, optical and X-ray scanning. Grainger says that over the course of making the six cowlings they were able to develop the process so that defects were reduced, and the parts became 'tighter' dimensionally.

Ten weeks after agreeing to take on the challenge of providing Hamilton Jet with the cowlings for its HTX30 engine it was on display, fully completed at Seawork in Southampton in July 2018. Since then the company has sold four units and has a further 22 on order from multiple military, workboat and recreational projects.

Going forward, Hamilton will produce the cowl parts at its own facilities in New Zealand, but the unit would likely not have made it to market on time to reap the commercial benefits of being displayed at the show without the rapid prototyping expertise of Grainger & Worrall. **i**

The parts were validated using CT, optical and X-ray scanning



HOW A WATERJET WORKS

A waterjet generates thrust by forcing water through itself in a rearward direction, propelling the vessel forward.

The jet is mounted inboard in the aft section. Water enters the jet unit intake on the bottom of the boat and is accelerated through the jet unit (impeller and stator) and discharged through the transom at a high velocity.

Steering is achieved by a driveshaft which changes the direction of the stream of water as it leaves the jet unit. To reverse, a deflector is lowered into the jet stream, reversing the direction of the force generated by it forward and down, to keep the boat stationary or propel it in the astern direction.

Adding a second, third or fourth waterjet enables greater positional control and manoeuvrability, especially when combined with Hamilton's Advanced Vessel Control (AVX) unit. This allows for smoother docking and includes a feature called 'JETanchor' which uses automatic vessel positioning and heading control to hold the vessel static in the water without using the anchor.





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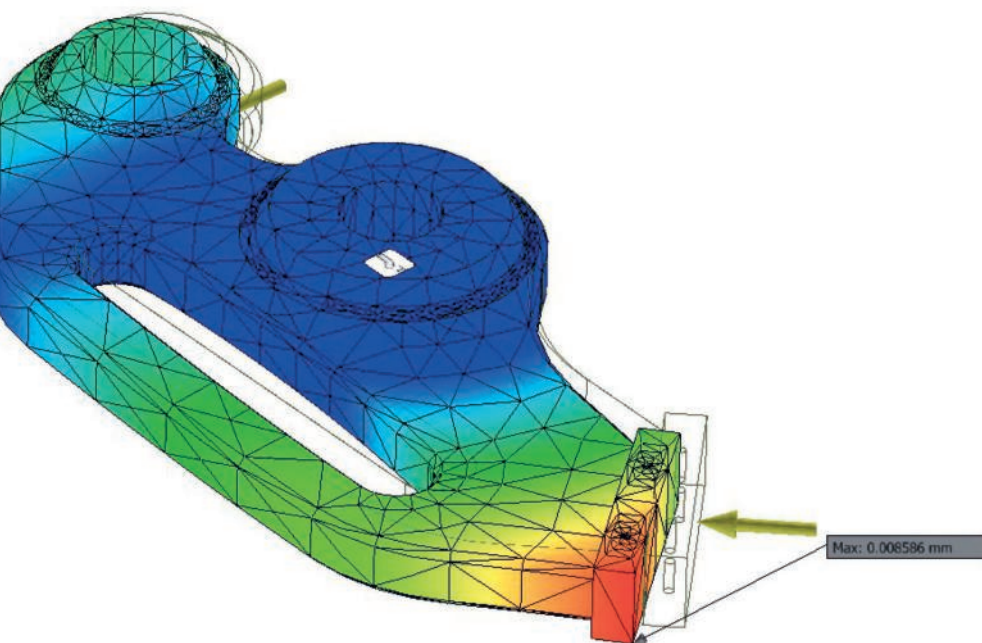


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JUST THE **START** OF THE JOURNEY

Anounced in the 2015 Autumn Budget, the UK Autodrive project was given the green light, and began on 1 November. One of three UK projects to research and develop connected and autonomous vehicles (CAVs), the others being the GATEway project's driverless pods in Greenwich Village and Venturer, which tested CAVs in Bristol, UK Autodrive took place in both Coventry and Milton Keynes.

The idea was that testing CAVs in real-world environments would help lead to greater levels of understanding for the producers of these vehicles as well as city authorities and urban planners. It would enable testing of the technology, but also the potential benefits in terms of pollution, congestion reduction, safety and crucially, how the public would see them fitting in to everyday life.

UK Autodrive was different from the other projects, not only because it was testing in two separate cities, but also because three different car manufacturers, Ford, Jaguar Land Rover (JLR) and Tata Motors European Technical Centre (TMETC), were taking part together.

By October 2016 the three manufacturers had demonstrated the project's first two connected car features on the HORIBA MIRA test track at Nuneaton. First, the 'Electronic Emergency Brake Light' where the car alerts the driver that a connected car in front has braked suddenly. This is to limit the number of rear-end collisions in poor visibility like heavy fog.

The second demonstration showed how connected cars can be sent information from traffic lights, allowing them to reduce the likelihood of meeting red lights by giving a certain speed for the driver to maintain – potentially improving



In under three years, the UK Autodrive project has led to autonomous pods becoming a normal sight on the pavements of Milton Keynes. What has been learned?

“There has already been a lot of public focus on self-driving vehicles, but connected car technology may be just as revolutionary”

future traffic flow and lowering emissions in urban areas.

“There has already been a lot of public focus on self-driving vehicles, but connected car technology may be just as revolutionary,” says Tim Armitage, Arup's UK Autodrive project director. “The benefits of having cars that can communicate with each other and their surroundings could be very significant – from increased road safety to improved traffic flow, more efficient parking and better information for drivers.”

June 2017 saw three more demonstrations. The 'Emergency Vehicle Warning System' warns connected cars that an emergency vehicle is approaching and from which direction, with the aim to minimise congestion and potentially reduce the time taken for ambulances, police cars and fire

engines to reach their destination.

During the 'Intersection Collision Warning' demonstration, the connected cars were able to detect the presence of other connected cars on approach to a junction and warn whenever there was a high probability of a collision.

The third involved 'In-Vehicle Signage', where the connected cars received traffic information sent from road-side units, ensuring that drivers do not miss out on important notifications, such as changes of speed limit or temporary lane closures.

JLR used this session to demonstrate its 'Autonomous Urban Drive'. An automated Range Rover Sport fitted with sensors including lidar, radar, GPS trackers and cameras, was able to navigate its way around an urban-style road network, successfully negotiating roundabouts and junctions while also steering around obstacles.

In November 2017, two years »

» into the project, CAVs from all three companies became the first in the country to be tested on open roads in the UK with the start of in-city trials in Coventry.

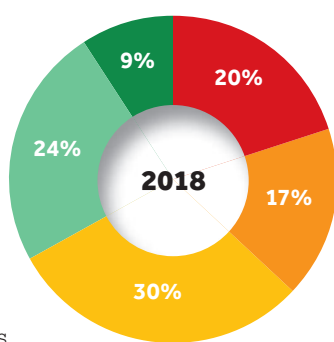
Ralph Wilson, project manager at Arup, says that the move from test-track to open roads was complex because of the many extra variables such as other road users and pedestrians, but what the trial really highlighted is the gulf between autonomy Levels 3, 4 and 5.

"Level 3 is where Tesla is at," he explains. "In certain scenarios the vehicle runs quasi-autonomously on a motorway, but the driver is still ultimately responsible and has to pay attention. Level 4 is when a vehicle will run autonomously and is good enough that the driver can switch off, but only in certain scenarios, like on motorways, or pods running in specific areas. Level 5 is when a vehicle can go anywhere autonomously."

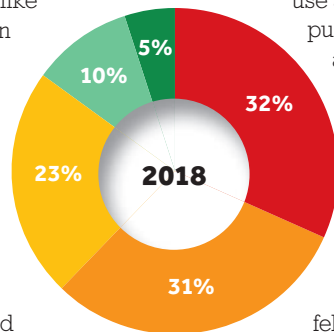
"The gulf between Level 4 and Level 5 is huge, to get to a point where you can jump in a vehicle and it will drive you out into the countryside, I think that's a long way out because the number of potential scenarios and variables are absolutely huge. I think we'll see Level 4 happening pretty soon – we are already, but Level 5 I think is a long time away."

April 2018 saw the first trials of 'Collaborative Parking', where the

When self-driving vehicles become available, I would use them



I would send my children to school in a self-driving vehicle



■ Strongly disagree
■ Disagree
■ Neutral
■ Agree
■ Strongly agree

CAVs used on-board parking sensors to send data to other connected vehicles to communicate where there are free spaces in car parks.

The three manufacturers also tested the Emergency Vehicle Warning System and Electronic Emergency Brake Light on public roads for the first time. Trials began for Aurigo's last-mile-serving autonomous pods too, with trips made between the train station and the Transport System Catapult's HQ, a distance of nearly half a mile.

A public attitude test was taken right at the start of the project before the pods and cars hit the streets. The same survey was conducted at the end of the project in October 2018. One of the main findings was that by 2018 people were surer they either did or did not wish to use a self-driving car, privately or as a public transport option. The strongly agree and disagree numbers went up a few percentage points while the neutral number decreased.

The big difference came when people were asked if they would send their child to school in one, where the numbers saying that they would fell by 2% while those that wouldn't rose by 3%.

Wilson says: "We polled around 3000 people around the country and the result was that people were remarkably open minded about the technology."



"There's always a small proportion of people at one end who are enthusiastic. It's like a gadget to them and they can't wait. And, at the other end those who love driving and don't like the idea of control being taken away from them. But then everyone else, a big proportion of people in the middle, are cautiously optimistic or open-minded."

Wilson says there's a lot to take away and analyse but there's still a lot of mileage left for Arup now UK Autodrive has reached its goal. The next phase for the companies that took part in the project, Arrup, Aurigo, RDM, JLR, Ford and TMETC will focus on taking some of the technologies further.

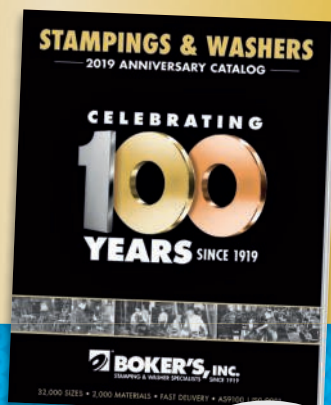
For example, Wilson says: "Potentially developing the technology around the pods but trying to trial more of a demonstration of service as well. There's also lots more public attitudes work to do."

"We've done some work around computational modelling to understand what the benefits could be in terms of reducing pollution and congestion and again there's just so much more you could do in that area, same with business case modelling, there's all sorts. But, the new funding rounds haven't been announced yet and it does always take a bit of time to get the wheels rolling on these projects."

"We'll stay very embedded in this area, potentially collaboratively with some of the partners and certainly individually, there'll be lots more to come." 📍



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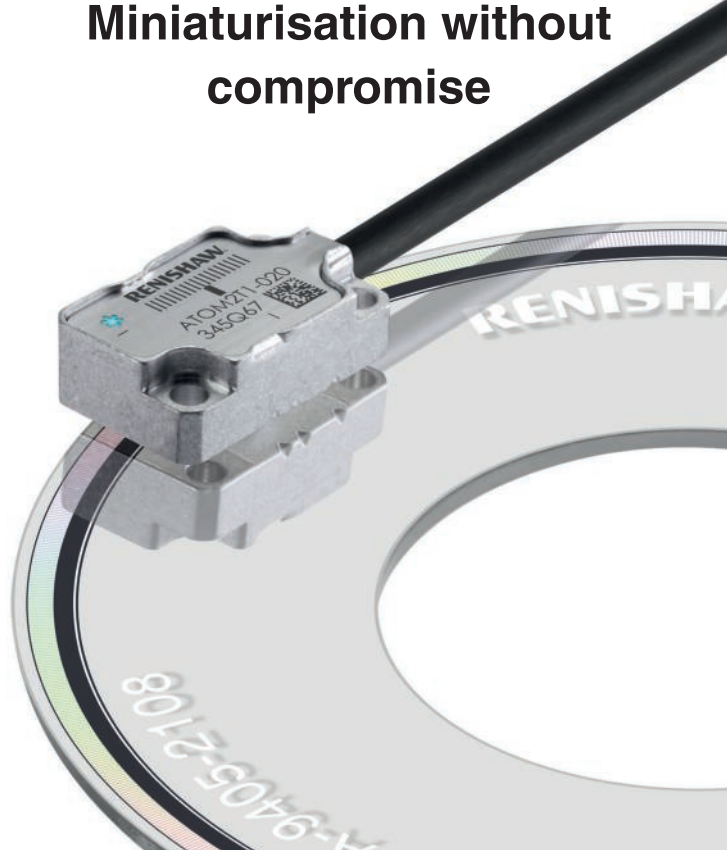
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The British Engineering Excellence Awards were launched in 2009 to champion and celebrate design innovation and excellence. Since then, the BEEAs have evolved as the number of companies entering to win the foremost engineering accolade for design has grown.

The BEEAs has been highlighting the breadth and depth of the UK's design engineering community and how it is competing on a global stage for the last 10 years. Winners of the Grand Prix, the best-of-the-best of each year, have ranged from individual engineers doing outstanding work both in their industries and communities, to small companies with staff numbers in the single-digits, to larger OEMs.

Each year, hundreds of entries are debated and analysed by a judging panel of industry experts, which includes the winners of the previous

year's Grand Prix and Design Engineer of the Year Awards.

National Instruments has been a sponsor of the event since 2009. Richard Roberts, senior customer marketing manager, National Instruments says: "The BEEAs always recognises a broad-range of innovative UK engineering firms, which align with the strong engineering and innovative heritage of the National Instruments brand. It also offers the opportunity to network with many eminent engineers and business leaders. National Instruments has sponsored the

Young Design Engineer award to help celebrate British engineering accomplishments and support the industry's most precious, valuable resource – the engineers of the future."

IN RETROSPECT

This is the third in a series of features looking back at the past winners of these awards and seeing how winning has affected them and their business.

The third British Engineering Excellence Awards ceremony took place at a gala luncheon on 13 October 2011 at London's Globe Theatre. The winners were:

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10th ANNIVERSARY

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NEW MECHANICAL PRODUCT OF THE YEAR

Sponsored by: Igus (UK)
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YOUNG DESIGN ENGINEER OF THE YEAR

Sponsored by: RS Components
Winner: **Darren Jones, Fireco**
Highly Commended: **Adam James**

DESIGN ENGINEER OF THE YEAR

Sponsored by: Mouser Electronics
Winner: **Shaun Addy, Cubewano**



WHERE ARE THEY NOW?

Consultancy of the Year is always a hard-fought category as the range of services provided and markets served varies significantly. In 2011, **Vocis Driveline Controls** won for its support of the automotive market, from global car manufacturers like Aston Martin, Lamborghini and McLaren to specialist suppliers in the UK, like ZYTEK, with which it worked on lighter, smaller and more efficient powertrains for its Motiv.e electric vehicle.

Vocis provides its customers with services from design and development through to integration, control and calibration of automotive transmission systems, as well as what it claims is the most advanced and most comprehensive range of transmissions for electric vehicles.

Innovation is central to the company's offering. Its technology enables customers to improve the

competitiveness of their products by refining performance, boosting controllability and reducing fuel consumption.

Shaun Addy won Design Engineer of the Year for his work on rotary engine design at Cubewano, as well as three decades of building, testing and designing high performance internal combustion engines at companies such as Lotus and BMW.

His rotary engine design ran on kerosene – the only engine in the world at the time with that ability and previously thought to be impossible. It was designed to be used in defence and aerospace applications. Cubewano won a \$9million order in 2010 from the US government for the engine to be used in unmanned aerial vehicles as part of a wider

future combat systems programme. However, the Obama administration terminated the programme, which effectively did for Cubewano as it had increased in size from 5 to 35 people just for that contract.

In 2017, Addy joined AIE (Advanced Innovative Engineering) where he continues to refine the designs of his rotary engines. Now though they're being used in greener applications such as range-extenders for electric vehicles, heavy lift drones and auxiliary power units in hybrid aircraft.

On winning the award, Addy says Cubewano's business picked up: "Big companies are always interested in who you are and what you've achieved. It definitely triggered some interest and we had various people wanting to make use of our engineering who wouldn't have contacted us had it not been for the coverage we received."

Addy states that companies with interesting projects should shout about them: "Promoting our own technologies and people is something I don't think we do enough. We are, typically, innovators and sadly it's typically foreign money that ends up being put behind the idea and it drifts off to other places. It's a shame, but it doesn't stop us from trying."

As winner of Design Engineer of the Year, Addy was invited back to judge the 2012 entries, something he says was one of the hardest things he's done: "I found it really challenging to plough through lots and lots of documentation in areas that weren't necessarily familiar to me. It made me further appreciate the award that I got because of the level of digging that you have to do and understanding at various levels. It gave me a very serious appreciation of what I'd received."

We will be covering the 2012 Awards in the March issue. Entries for the '10th anniversary' awards will open in the Spring, so why not visit www.beeas.co.uk to pick up some top tips on entering your submissions. **i**



Above: Winner of Design Engineer of the Year Shaun Addy with his trophy

Top: The winners of the 2011 BEEAs

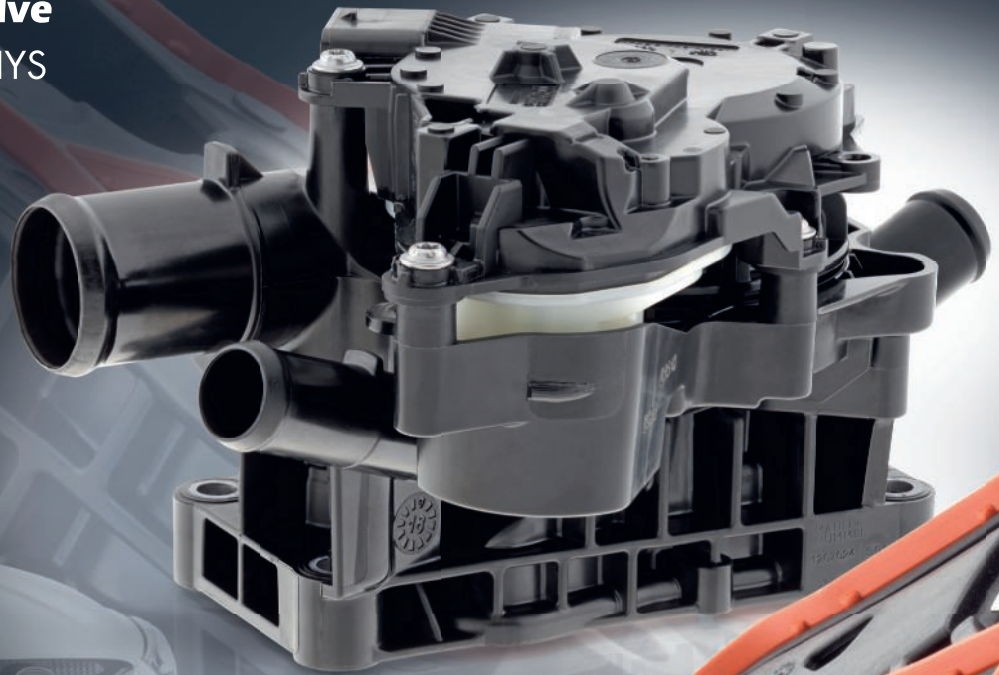
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THE ROBOTS ARE COMING

Are robots really going to take our jobs? Chemigraphic's NPI director, John Johnston asks: what does industry really have to fear from robots – and what does it have to gain?

The word 'robot' comes from the Czech word 'robota', which means 'forced labour'. It's no surprise, then, that much of the fear that exists in the manufacturing sector about robots relates to their impact on employment.

WHEN DOES AUTOMATION BECOME ROBOTICS?

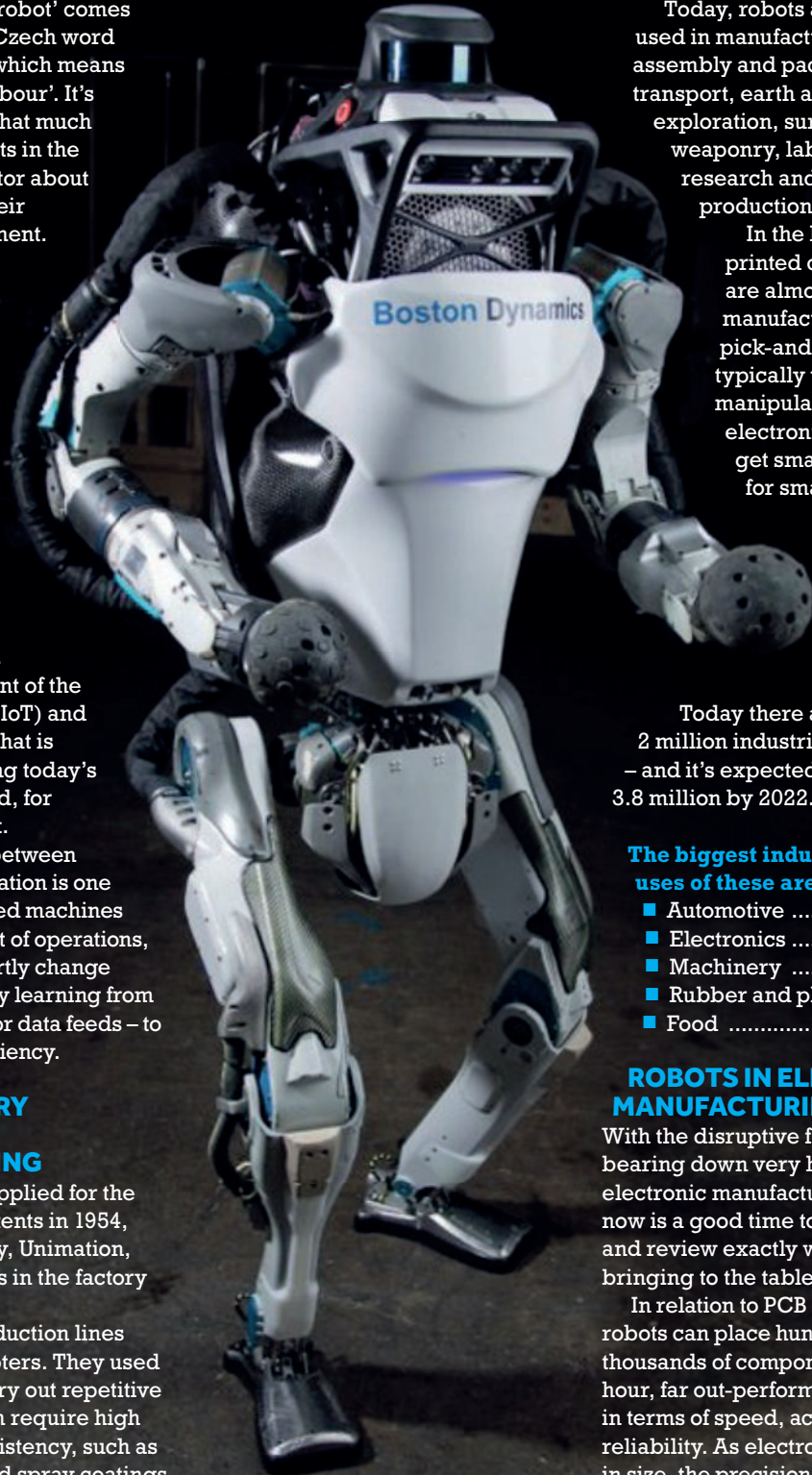
The reality is that robotics – or at least advanced automation – has been widely used in manufacturing since the 1970s.

Robotics is automation plus AI. It's the recent advent of the Internet of Things (IoT) and machine learning that is increasingly making today's robots so useful and, for some, such a threat.

The difference between robotics and automation is one of degree: automated machines perform a single set of operations, but robots can smartly change their behaviour – by learning from sensory feedback or data feeds – to achieve better efficiency.

A BRIEF HISTORY OF ROBOTS IN MANUFACTURING

- George Devol applied for the first robotics patents in 1954, and his company, Unimation, was using robots in the factory by 1956.
- Automotive production lines were early adopters. They used machines to carry out repetitive processes which require high amounts of consistency, such as spot welding and spray coatings.
- Sophisticated robotics in warehouses have been directing goods for dispatch for many years.



Today, robots are widely used in manufacturing, assembly and packing, transport, earth and space exploration, surgery, weaponry, laboratory research and mass production.

In the EMS industry, printed circuit boards are almost exclusively manufactured by pick-and-place robots, typically with SCARA manipulators. As electronic components get smaller, the need for smarter robots increases.

Today there are more than 2 million industrial robots in use – and it's expected there will be 3.8 million by 2022.

The biggest industrial uses of these are:

- Automotive 33%
- Electronics 32%
- Machinery 12%
- Rubber and plastics 5%
- Food 3%

ROBOTS IN ELECTRONICS MANUFACTURING

With the disruptive force of robots bearing down very heavily on the electronic manufacturing industry, now is a good time to take stock and review exactly what robotics is bringing to the table.

In relation to PCB manufacturing, robots can place hundreds of thousands of components per hour, far out-performing a human in terms of speed, accuracy, and reliability. As electronics shrink in size, the precision of robotic production methods becomes essential. Robots can do much more than just build, place and weld. »

» They can also quickly and accurately check all the components to ensure they match the required spec and are placed accurately.

Add into the mix IoT sensors and the benefits really stack up. Using data from connected, always-on devices robots can respond to situations in real time, becoming smarter and more aware. A robot can speed up or slow down based on its surrounding or the timings of small-batch production cycles and it can collaborate with other robots to work more intelligently.

Here are some of the benefits that robots are already delivering:

- They can work in dangerous environments.
- They can work faster and with more precision.
- They can create efficiencies throughout the manufacturing process.
- They can operate 24/7 for continuous production.
- They can perform complex functions that are essential for the latest generation of smaller products.



John Johnston,
Chemigraphic

WHY ARE WE STILL AFRAID?

Despite these advantages, there remain fears that continue to hold back electronic manufacturers from embracing robots.

1 Robots will steal our jobs

The cost-efficiencies of robots can help companies become globally competitive once more, by reversing the offshoring trend by creating jobs and reshoring manufacturing work.

Robots protect workers from repetitive, mundane and dangerous tasks, while creating more desirable jobs, like engineering, programming, management and equipment maintenance.

Robots will not steal our jobs. They will enable us to gain new skills and compete more effectively for work we had lost.

2 Robots are too expensive to invest in

Robots' throughput and output gains tend to achieve ROI for manufacturers quickly, often within two years.

Manufacturing robots are much more affordable today as standard robot models are now mass-produced. Robotics as a service (RaaS) lowers the entry barrier further through rent-based pricing.

3 Robots will destroy established work cultures


This fear is well-grounded: fully integrating robotic solutions often requires fundamental changes to the way businesses operate. This disruptive potential may entail changes to software

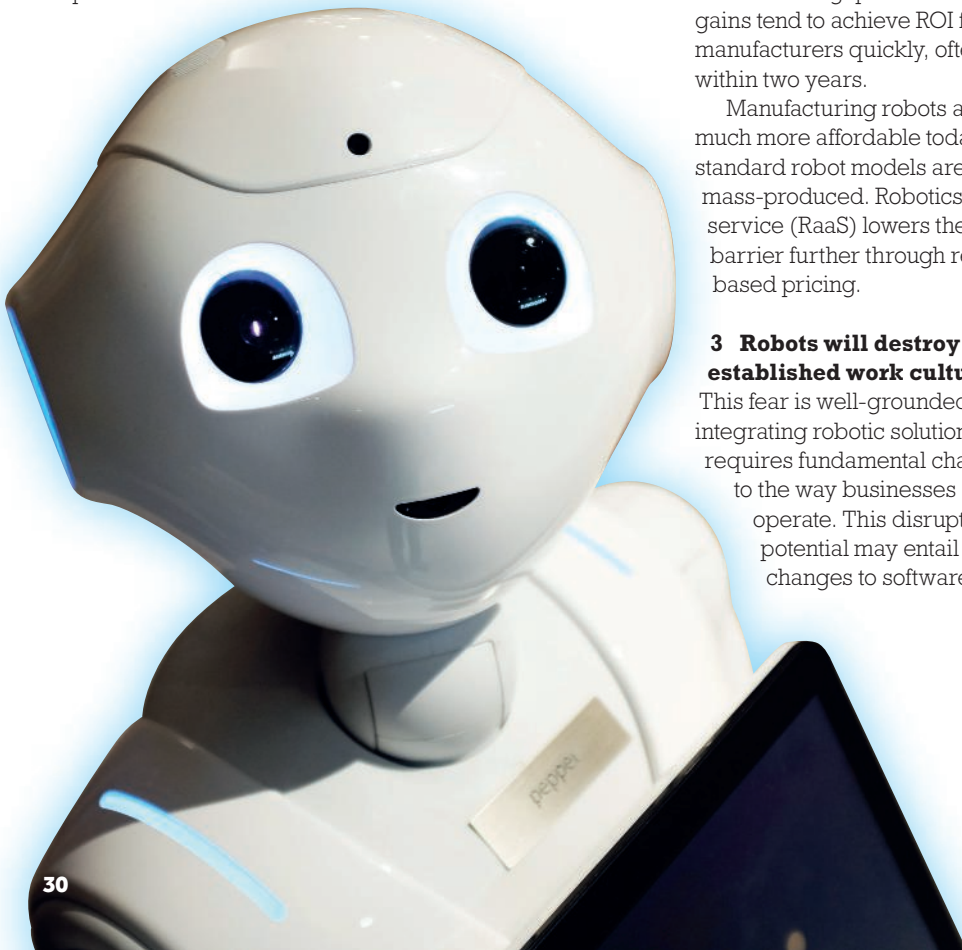
platforms, material consumption, supply chains, ERP, MRP and even the working culture of a business. Yet, these changes are for the good. They introduce enhanced capabilities, realise efficiencies, result in cost-savings and create better products.


HOW CHEMIGRAPHIC USES ROBOTICS

Electronics manufacturers can continually enhance and improve the services they offer. Robotics and IoT are a part of this, but it's the investment in skills, talent and staff that will optimise these new technologies.

- Additive manufacture is already commonplace for Chemigraphic in areas such as enclosure development, specialist antennas and waveguides.
- Our Design Centre collaborates closely with our customers to take advantage of new technologies.
- Our inspection tools are automated and sophisticated, offering 3D scanning and X-Ray.
- Wireless monitoring systems are used to remotely check a range of conditions, including stock on shelves, reels on feeders and temperature or humidity in production areas.
- As more RF-ID and IoT sensors collect more data, we expect to introduce new automated tracking and production systems.
- We have libraries of complex database analysis and metric capture tools displaying data on dashboards so that it can be immediately responded to. Machine learning and automated responses will be central to our monitoring and decision-making over the coming years.

At Chemigraphic, we welcome the efficiencies and productivity gains that the further integration of robots, AI and data capture will bring. We intend to harness this to deliver better service and better products. We are not afraid of the Big Bad Bot! Are you? 





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



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Engineering Materials

HELPING INDUSTRY FIND THE **RIGHT** MATERIAL FOR THE **RIGHT** APPLICATION

37

**Metals bring
material benefits
to manufacturers**

40

**Can bioplastics
be the answer?**

CARBON FIBRE ROBOTS

East-Midlands-based Rutland Plastics, which produces parts for industries such as medical, consumer goods and utilities, has recently acquired a Stratasys Fortus 380mc Carbon Fibre edition to break new ground in collaborative robotics.

Simon Grainger, design and project engineering manager at Rutland Plastics, said: "3D printing gives us greater design flexibility. It allows us to design end-of-arm tooling and jigs and fixtures for their specific purpose, and complexity doesn't increase cost."

The Fortus 380CF can print 30% carbon filled nylon, which is suited for producing end-of-arm tooling as it is strong and durable but also lightweight, meaning robots can run faster and their payloads can be maximised.

Mr Grainger added: "This is our first introduction into carbon fibre printing and it's become massively important to the way that we produce all of our jigs and fixtures, and especially end-of-arm tooling.

"We can incorporate features and mechanisms such as air channels, and we can also use GrabCAD software to pause prints so that we can stop and put components into the actual 3D-printed parts, such as magnets and sensors, and completely encase them."



TATA STEEL RESTARTS UK BLAST FURNACE

Tata Steel has completed a major project, costing tens of millions of pounds, to extend the operational life of one of its two blast furnaces at the Port Talbot site by five to seven years.

Hans Fischer, chief executive of Tata Steel's European operations, said it was "the biggest single investment we have made here for more than five years. This project demonstrates our commitment to building a stronger and more sustainable steelmaking business in the UK, now and in the future."

Once the furnace, which normally runs at more than 1,200°C, cooled in the autumn

skilled engineers replaced part of the heat resistant interior and vital structural parts as well as the waste gas and dust extraction system.

Following the relighting of the furnace, the first iron has now been produced and turned into a finished steel product before being delivered to a manufacturing business in the UK.

Confirmation of this project came at the same time as the announcement in June 2018 of definitive agreements being signed by thyssenkrupp and Tata Steel to form a joint venture of their European steel businesses.

WELDING THE UN-WELDABLE ALLOY

Aluminium alloys could be used to make cars and bicycles lighter, but for one key obstacle. Although they're nearly as strong as steel and one-third the weight, they're almost impossible to weld together.

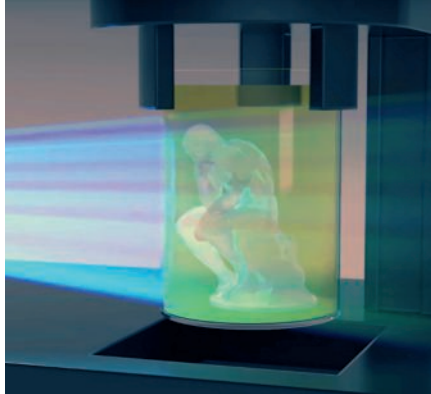
When heated during welding, cracks form due to their molecular structure creating an uneven flow of its constituent elements – aluminium, zinc, magnesium and copper.

Now, engineers at the UCLA Samueli School of Engineering claim to have developed a way to weld the alloy, AA 7075, by infusing titanium carbide nanoparticles into AA 7075 welding wires, which are used as the filler material between the pieces being joined.

The researchers said this approach produced welded joints with a tensile strength up to 392 megapascals. Also, post-welding heat treatments could increase

joint strength to 551 megapascals, which is comparable to steel.

Xiaochun Li, Professor of Manufacturing at UCLA, said: "Companies could use the same processes and equipment they already have to incorporate this super-strong aluminium alloy into their manufacturing processes, and their products could be lighter and more energy efficient, while still retaining their strength."



REAL-LIFE REPLICATOR

Inspired by Star Trek's replicator, engineers at the University of California, Berkley have created a 3D printer that can transform objects from liquid in minutes.

The group says it can create smoother, more flexible and more complex objects than is possible with traditional 3D printers. It can also encase an existing object with new materials - for instance, adding a handle to a metal screwdriver shaft - which current printers struggle to do.

The 'replicator' projects carefully crafted patterns of light onto a rotating cylinder of a viscous liquid resin which solidifies the desired shape "all at once".

Besides patterning the light, which requires complex calculations to get the exact shapes and intensities right, the other major challenge faced by the researchers was how to formulate a material that stays liquid when exposed to a little bit of light but reacts to form a solid when exposed to a lot of light.

The resin is composed of liquid polymers mixed with photosensitive molecules and dissolved oxygen. Light activates the photosensitive compound which depletes the oxygen. Only in those 3D regions where all the oxygen has been used up do the polymers form the "cross-links" that transform the resin from a liquid to a solid.

BREAKTHROUGH IN COMPOSITE PROCESSING

Shape Machining has launched the Shape FastForm process to drastically reduce the time it takes to manufacture thermoplastic carbon composite parts.

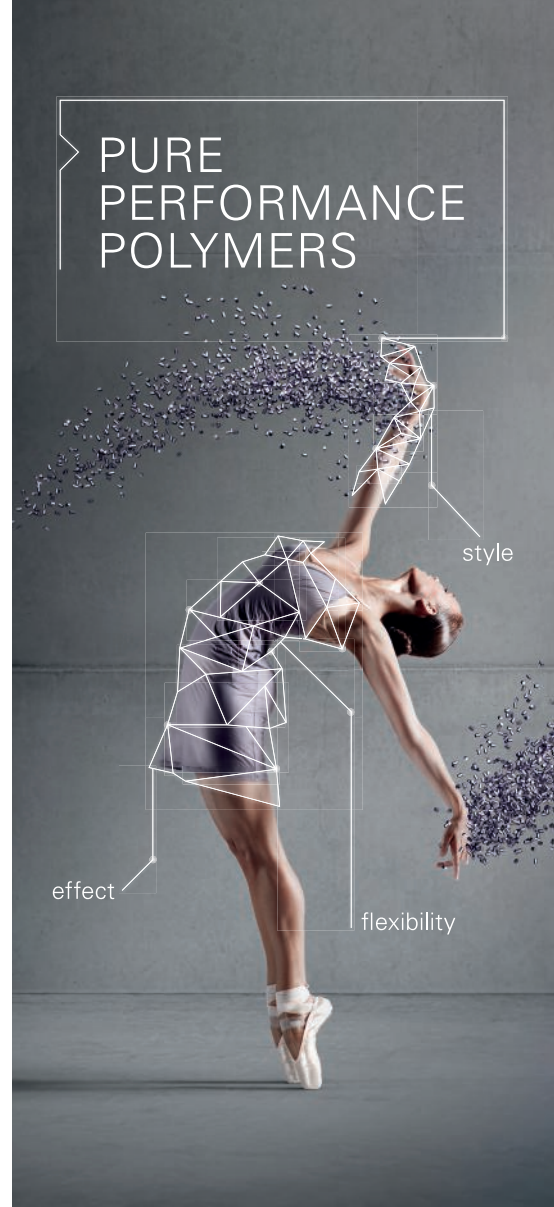
Managing director, Peter McCool, said: "The ability to manufacture carbon parts in minutes, reliably and in a fully automatable process is a significant breakthrough. We aim to be the UK centre of excellence for thermoplastic composite production."

The footplate design, that was used as the development part, was pressed in a sub two-minute cycle time. They were rapidly heated and cooled in a closed mould, at 80 bar and consolidated it into the finished parts.

These parts are not only produced quickly, but they also appear to be void free.

The Shape FastForm process has been used to test a range of thermoplastic materials, from many material suppliers. Every material that was tested was processed quicker than any other composite processing technology.

McCool added that production runs from 50 to 30,000 per annum will be achievable using FastForm. But when the process is fully automated, volumes of 100,000 per tool per annum are possible.



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EMS-GRIVORY - Your innovative development partner

Q What is a weld line?

Generally the confluence of flow fronts is called a weld line. Weld lines are very common and can be found in nearly all plastics applications.

Q How are weld lines caused?

There are two major causes responsible for a weld line; number of gates and/or design reasons.

If a cavity is simultaneously filled by more than one gate, several flow fronts exist and create a weld line when merging together. We can distinguish between flow fronts merging in a frontal or in a parallel way.

Obstacles like holes are the most obvious design reason for a weld line to be formed. Nevertheless, sudden differences in wall thickness, branching in the design or different flow path lengths are additional causes for weld lines.

Q What needs to be considered with regard to weld lines?

Due to their frequent occurrence, every designer and tool maker should be aware of the difference a weld line can make.



Surface quality can be affected by a weld line. Like sink marks, weld lines can be visible in case of unfavourable processing. EMS-GRIVORY not only provides detailed support in design and processing of top-surface applications, but offers tailor-made products such as Grilamid TR piano black, where weld lines are nearly invisible. Mechanical strength of components made of fibre reinforced plastics will also be influenced by weld lines. EMS-GRIVORY has many years' experience in handling all issues related to weld lines, providing support for customers and offering solutions every day.

Q How does EMS-GRIVORY provide support?

EMS-GRIVORY offers the broadest assortment of polyamides and with first hand knowledge of its products is able to provide the adequate material for every application. As a strong development partner, EMS-GRIVORY supports its customers throughout the whole development process from feasibility studies to serial production.

Q Which concrete solutions can EMS-GRIVORY offer?

For challenges like improvement of mechanical properties in weld lines, EMS-GRIVORY's Application Development Centre has extensive experience and can provide different solutions. One is the installation of an overflow-cavity adjacent to the weld line. Another solution can be the EMS-cascade-switching approach. A second hot runner gate will open right after emerging of a weld line. This gate will generate a new pressure and flow condition causing the melt to flush through the weld line. In this way, the misarranged fibres can be reoriented properly. This solution increases a part's life expectancy by many times, especially for long-term applications such as water meters.

Don't leave it to chance! Be assisted by EMS-GRIVORY in your future developments.



INNOVATION brings material benefits

The transformative effects of new material development on design and manufacturing processes are well understood by Morgan Advanced Materials.

The use and availability of new materials sometimes not merely enhances an existing design or process, it revolutionises it entirely. As a global leader in materials manufacturing, Morgan Advanced Materials has more experience than most of this phenomenon and has developed a proprietary leachable material which significantly cuts investment casting times in turbine engine blades by up to 20%.

The development comes as the commercial aerospace industry is facing a significant overhaul. According to Market Research Future, the commercial aircraft turbine blades

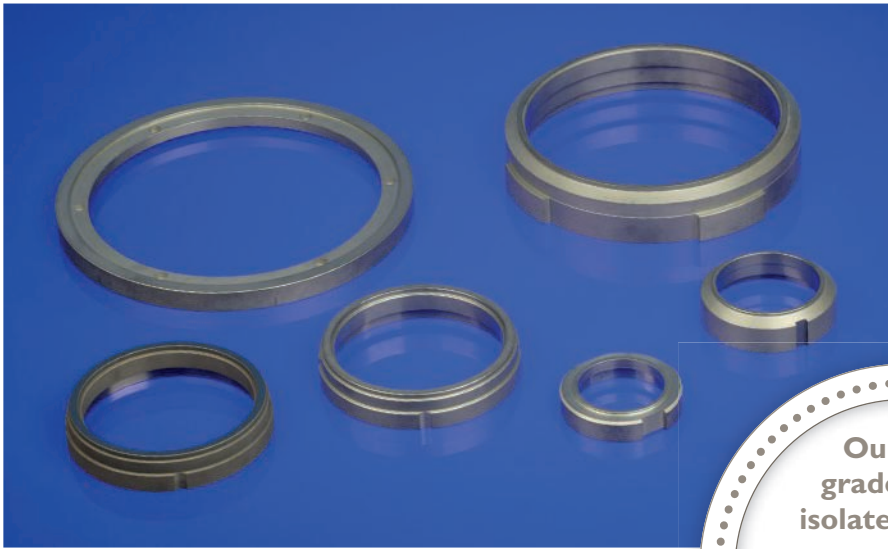
and vanes market is forecasted to grow at a compound annual growth rate of 6% by 2023.

High fuel prices, stricter regulations on noise and carbon dioxide emissions, and an increase in competition from low cost carriers are factors which are forcing manufacturers to develop modern aero-engines that are lightweight and fuel efficient.

To help aerospace investment casting businesses meet this surge in demand, the Technical Ceramics business of Morgan Advanced Materials has developed the LEMA range of proprietary alumina-based materials. The new material shortens leaching cycles

for alumina core support rods used in the production of turbine engine blades, while still providing the significant mechanical strength needed for robust production.

Typical alumina rods are renowned for their strength and load bearing capabilities. However, it can take several days to fully leach the materials, resulting in delays in the production process. In comparison, like-for-like LEMA 250 parts will experience an approximate 20% mass reduction after 20 hours (at 149°C and 185 psi). A comparable alumina part to LEMA 250 does not show any mass loss under the same conditions.



Jennifer Kachala, product engineer at Morgan's Technical Ceramics business said: "At a time when demand for turbine engine blades is expected to grow substantially over the next few years, the enhanced leachability of LEMA rods has been developed at exactly the right moment to help shorten processing times for casting manufacturers.

"Investment casting businesses will need to prove they can meet demand for the ramping build schedules of new engine programs. LEMA can help them achieve this while saving on costs."

The enhanced leachability of LEMA drives more cost and time savings. While quartz support rods can offer a cost-effective solution to alumina in terms of leachability, they do not have the mechanical strength of LEMA. This makes them less suitable for applications where part geometries and alloys require higher strength support rods. LEMA components are approximately 1.5 times stronger than quartz equivalents.

"The investment casting industry has experienced the pain of long production times for years due to legacy materials and leaching processes. Morgan has overcome this challenge with LEMA," said Kachala. "Our material has been extensively tested, optimised to deliver strength and shorten production times, reducing cycle times and costs in casting turbine blades.

"As a result, our customers can now meet demand, with improved quality for the aerospace and industrial gas turbine industries."

Another example of the way in which

Morgan's technical innovation in materials has transformed a product is in the manufacture of pumps. Here, the manufacture of clean pumps used in food & beverage, pharmaceutical and cosmetics factories is likely to be affected by the ban on environmentally harmful polymer microbeads, these are currently used in pump construction but are harmful to sea life. The UK and US Governments have banned their use in certain applications already – mostly in cosmetics – with further extensions likely to follow.

A new micro-structure manufactured by Seals and Bearings, a business of Morgan Advanced Materials using porous Silicon Carbide (SiC) is being cited as the answer, offering effective pore forming to help pumps perform for longer.

Thanks to Morgan's expertise in volume precision ceramics manufacturing – and the flexibility to 'press to size' to suit customer needs – its new SiC grade is suitable for delivering seal faces in high volumes, even for complex designs.

Porous seal rings are vital for long-term pump performance. For companies manufacturing Fast Moving Consumer Goods (FMCG) no contamination is allowed and seal rings must maintain integrity. Friction naturally occurs as the two mechanical seals run against each other; over time, this can affect seal performance and potentially cause leakage. The answer is to add pores, which act as pockets for processing fluid. This fluid acts as

Our new grade offers isolated, round pores on the seal faces which act as 'pockets' to retain processing fluid

a lubricant to substantially reduce friction – but the most popular industry solution currently on the market also uses polymer microbeads to create the required microstructure.

The ban on these presents a significant risk to the supply chain in pump manufacture, but Morgan has pioneered a new material that is expected


to offer similar properties to the

current solution without posing this risk to the environment.

"In conversations with customers, we've been shocked that many aren't aware of the ban and the danger it poses to their long-term productivity. Our new porous grade of silicon carbide has been devised to give customers a more sustainable means of supplying pumps that are effectively sealed and lubricated during operation," explains Yifei Zhang, business development manager at the Seals & Bearings Business of Morgan Advanced Materials.

"Our new grade offers isolated, round pores on the seal faces which act as 'pockets' to retain processing fluid for effective lubrication. This is highly preferable for food or pharmaceutical applications, to graphite-based dry lubrication systems which offer an increased risk of undesired contamination.

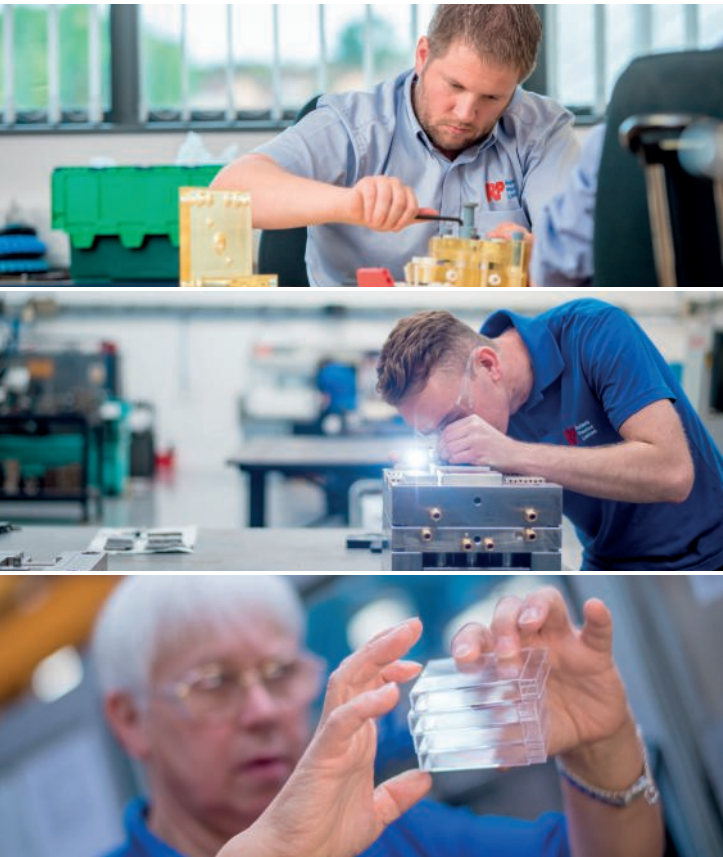
"Morgan's 'press-to-size' technology minimises subsequent machining processes. This works even for parts with complex geometries, meaning we're able to manufacture seals to the final tolerance required by the customer."

The addition of porous SiC adds to Morgan's portfolio of materials for mechanical seal faces, alongside its existing sintered SiC (PS5000 grade) and graphite loaded SiC (PGS3 grade). 



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Beating the plastic dilemma

The environmental impact of plastic is driving the development of more and more bio-based plastics. But these can pose their own difficulties.

There can be few hotter topics in the materials sector than the use of plastics. For more than 50 years, global production and consumption of plastics have continued to rise. In 2016, the world produced around 335 million tonnes. However, continued support for the introduction of bio-based products continues to gain momentum, suggesting that wider market penetration is around the corner. Market data shared at the 12th European Bioplastics Conference last November indicated: "Global production capacities of bioplastics are expected to grow by 20% in the next five years."

According to ProBI, 85% of plastics could technically be substituted with bio-based plastics, reducing dependency on those derived from fossil-based resources. Yet, right now bioplastics represents just 1% of the annual plastics production. Making a difference is a joint effort that requires industry stakeholders, manufacturers, suppliers and consumers being better informed and educated about the challenges and having legislative and regulatory frameworks that actively promote sustainable development and supports innovation.

Until recently the focus has been on bio-based PET. However, the scale of adoption has not been as rapid as anticipated. In Europe, the focus is now shifting to the development

of PEF (polyethylene furanoate). Expected to enter the market in 2020, this new polymer is said to feature superior barrier and thermal properties, making it comparable to PET and therefore suitable for the packaging of drinks, food and non-food products.

This raises the question for injection moulders of whether they need to invest in new processing equipment? Not necessarily, says Nigel Flowers, UK managing director at Sumitomo (SHI) Demag. "In theory, you can run bioplastics through an injection moulding machine just as you would any other polymer. The main issue lies in how that plastic performs as an end product, which will dictate what applications it can be considered for."

Drop-in plastics, such as bio-based PE, bio-based PET, or bio-based polyamides typically have the same technical and functional properties as their conventional counterparts. Used in high-demand and durable applications such as electronics, building and construction, automobiles, and consumer goods, they can, in the main, be processed and recycled in the exact same way. However, other innovative bioplastics such as PLA or starch-based plastics desired for food packaging and in agricultural applications, have different properties, such as improved barrier or compostability.

"If the bioplastic materials properties differ from the material it's intended to replace, it



can have an impact on the production costs of the article in question," notes Flowers. As a result, careful consideration should be given to the selection of the material and products chosen.

Some bioplastics have yet to fully meet the performance requirements needed to lend themselves to more durable goods. That's not to say it won't happen. Heat resistance, enhanced moisture barriers, greater rigidity and flexibility and durability are improving.

Automobile companies are making great strides. Bio-based or partially bio-based commodity plastics such as PE or PET are already being used for applications like car dashboards. Currently, packaging is the leading segment, accounting for almost 60% (1.2



**Packaging
is the leading
segment, accounting
for almost 60%
of the total
bioplastics market
in 2017**

million tons) of the total bioplastics market in 2017.

Three major process technology and equipment specialists, Futerro, Sulzer and TechnipFMC, have formed the PLANet initiative to promote the production of sustainable plastics made of Polylactic Acid (PLA). The collaboration will support manufacturers interested in entering the bioplastic market by delivering integrated PLA technology packages.

PLA is a versatile bio-based, biodegradable polymer that can replace petroleum-based plastics in a range of applications. Many stages are required to convert sugars from crops into lactic acid, lactide and subsequently PLA.

Futerro, a well-established technology provider for lactic acid and lactide production, and Sulzer Chemtech, a specialist in separation and mixing technologies have over 25 years of experience in lactic acid and PLA's related processes. Together they have further shown their commitment to facilitate the production of bioplastics by establishing a partnership with TechnipFMC, a leading global EPC contractor with experience in technology development and licensing with fast growing activities in bioplastics and green chemicals.

The agreement between the three parties offers to agricultural, chemical and fibre industries, a fully integrated package addressing the whole PLA value chain. In this way, customers can benefit from direct access to state-of-the-art, customisable solutions for all the aspects and stages of PLA production. PLANet offers the possibility of a "one-stop shop" for customers interested in PLA production by providing a single point of contact and responsibility.

In particular, PLANet supports the construction of plants of any size, including PLA facilities with a throughput of up to 100,000 tons per year - that permit manufacturers to save both capital expenditures (CAPEX) and operating expenses (OPEX) by providing for integrated and optimised plant section design.


Within the PLANet partnership, Futerro's proprietary technology focuses on the production of lactic acid and raw lactide from sugar or, directly, from biomass; Sulzer contributes the process for the purification of lactide and its polymerisation to obtain PLA while TechnipFMC acts as technology integrator to deliver seamless and optimised

Front-End Engineering Design (FEED) packages.

Another intriguing bioplastic development comes from Teysha Technologies, which has developed a natural polycarbonate platform that can create fully biodegradable substitutes for existing petroleum-based plastics. The bioplastic, AggiePol, is derived from sustainable feedstocks and can be physically, mechanically and chemically tuned to suit the needs of its intended application. The versatile material could replace the traditional plastic used in the automotive industry and medical equipment.

Teysha's technology uses a plug-and-play system that takes monomers and co-monomers, the natural building blocks of plastics, to create an eco-friendly alternative to traditional polymers. Instead of using hydrocarbon-based petrochemicals, which are sourced from fossil fuels and generate various pollutants in the manufacturing of the material, Teysha's platform uses natural products such as starches and agricultural waste products.

By controlling the chemistry, formulation and polymerisation conditions, the polycarbonate materials created by Teysha's technology can be precisely tuned. Unlike existing bioplastics such as PLA and PHA, it is claimed that the degradation rate of Teysha's AggiePol can also be tuned, minimising the environmental impact of plastic products after the end of their useful lifetime.

"In the sea, existing plastics often break down into microplastic particles that can be consumed by marine life and ultimately work their way up the food chain and end up on our dinner plates," explained co-inventor and head of research at Teysha Technologies, Dr Ashlee Jahnke. "The ultimate fate of plastic materials and whether they breakdown must be taken in to consideration, as many plastics can persist in the environment or landfills for thousands of years." 



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Model makes the grade

The construction of the AW609 wind tunnel model through 3D printing technology and carbon-composite material offers a range of new possibilities.

One of the more significant applications in the aerospace sector is the new wind tunnel model of the Leonardo tiltrotor AW609 manufactured by CRP Technology for Leonardo Helicopter Division (Leonardo HD, formerly known as Agusta Westland).

This project allowed CRP Technology to highlight the perfect union between advanced 3D printing technology (Selective Laser Sintering) and Windform high-performance composite materials. Thanks to these materials, it was possible to complete and test the model in the wind tunnel within a very short period of time, with excellent results and with high-performing mechanical and aerodynamic properties.

The project related to the manufacturing of some external parts (nose and cockpit, rear fuselage, nacelles, external fuel tanks, fairings) of the 1:8.5 scale wind tunnel model for the prototype of the new Leonardo HD tiltrotor AW609, made by Selective Laser Sintering technology and Windform XT 2.0 Carbon-composite material, both supplied by CRP Technology. This wind tunnel model was designed,

manufactured and assembled under the supervision of Leonardo HD by Metaltech S.r.l. for a series of dedicated low speed wind tunnel tests.

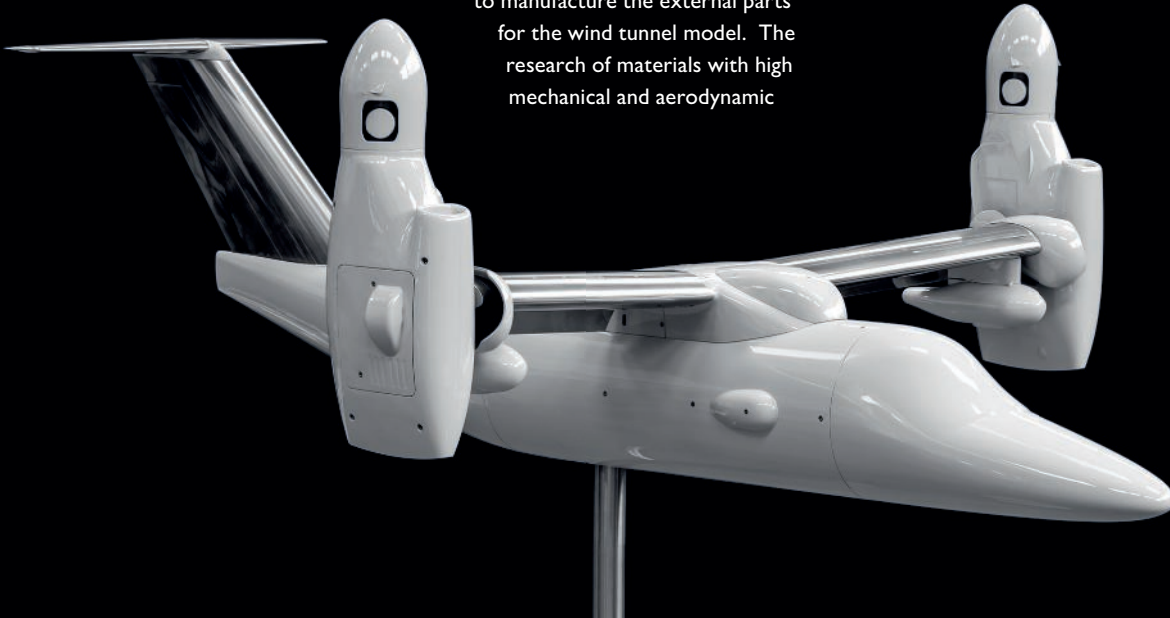
The low-speed wind tunnel tests were intended to cover a standard range of flight attitudes to be performed at the Leonardo HD wind tunnel facility and at Politecnico of Milan for the high angles of the flight envelope. During the different test sessions, various external geometries were changed and checked in order to understand all the aerodynamic phenomena. The main external components that were redesigned and manufactured include: fuselage and nose components, fairings, nacelles and spinner shapes, empennage, wings and flaperons.

Leonardo HD needed to meet a very short timetable, but with the highest level of reliability and commonality in order to manufacture the external parts for the wind tunnel model. The research of materials with high mechanical and aerodynamic

It is important that the components of the external fairings don't deflect too much under load

characteristics for these components usually would have involved a classical composite material. Instead, the choice was to design and manufacture an aluminium alloy internal main structure that can easily be implemented with new geometries for the future aircraft versions or improved solutions.

It is crucial for the applied loads to be sustainable and therefore these could not be underestimated. Indeed, the aerodynamic loads of the wind in the tunnel are very high. The most critical aspect of the project is therefore the resistance to the loads, but also the need to maintain good dimensional tolerances of such a large-dimensioned component under load. It is important that the components of the external fairings don't deflect too much under load. In addition, even when there are no external loads, the product must have dimensional characteristics





in respect of the supplied specifications. It is important to remember that the performance of these components affects the final performance of the entire project, especially because the external fairings have to transfer the aerodynamic loads generated by the fuselage to the internal frame.

To ensure the model had the capacity to withstand the loads expected during the various wind tunnel testing phases, stress and strain calculations were performed. Such structural strength assessments were executed for all the critical model components and for the assigned loading conditions.

The envelope of the expected model load conditions, obtained by scaling the full scale reference values, was fundamental to enabling the requested structural evaluation. It also had to ensure that a component's final design capabilities could guarantee full compatibility with both wind tunnel constraints (e.g. supports) and equipment (e.g. internal/external balances). Model components' materials and related stress limitations, stress concentrations, fatigue, were also discussed during the design phase.

The tunnel model manufacturing technique has changed over the years. Historically, such components would have been made by a classical

composite material technology. The biggest restriction of this technology was the long manufacturing time. Leonardo HD's first wind tunnel models were manufactured using wood and metallic components and then changed to a mixed solution of wood and composite fibre materials. Today, all models are manufactured using a CAD/CAM approach; an internal structural aluminium and steel frame is milled and assembled and all the external geometries are obtained through 3D printing techniques. Advanced 3D printing combined with the Windform XT 2.0 material was chosen by Leonardo HD, thanks to its short manufacturing time and high-performance features.

Process and result

The activity of CRP Technology was based from the beginning on the maximisation and achievement of the requested goals.

The work started from a careful analysis of the dimensional designs received from Leonardo HD. Thanks to the wide-ranging experience of CRP Technology in this market, and its detailed knowledge of the materials and the technology, it was possible to assist Leonardo HD in the choice of the best composite materials.

Choosing Windform XT 2.0 composite material was an in-depth process, with all the goals required by Leonardo HD considered, such as the importance of a short realisation time, good mechanical performances and also good dimensional characteristics. Windform XT 2.0 is a ground-breaking carbon fibre reinforced composite 3D printing material known for its mechanical properties, suitable for many applications such as use in wind tunnels, because of its high heat deflection (HDT = 173.40 °C; test method= ISO 75-2 TYPE A), superior stiffness and first-rate detail reproduction. It replaces the previous formula of Windform XT in the Windform family of composite materials: Windform XT 2.0 features improvements in mechanical properties including +8% increase in tensile strength, +22% in tensile modulus, and a +46% increase in elongation at break.

The first issue concerned the dimensions of the prototype: since some components were dimensionally superior to the construction volume of the 3D printing machines, it was necessary to manufacture the single parts separately. The experience and knowledge of this process by CRP Technology's staff have allowed the analysis, the study and the consequent creation of such a complex project without any delay or problem for the client.

From the beginning the work was focused on the design of the components, with a correct split of the parts, considering of course the working conditions and the stress that the components would have to sustain. [M]

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such components
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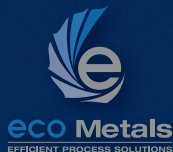
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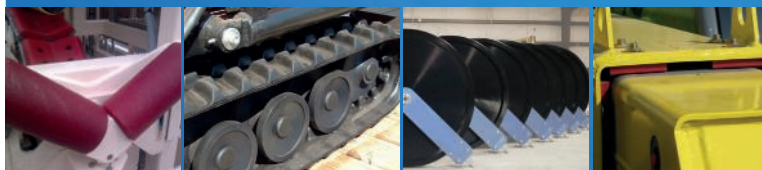
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ENGINEERED PRODUCTS



New large-scale resin infusion capabilities at the NCC will enable full-scale demonstration of wind, aerospace and infrastructure manufacturing capabilities

RESIN SCALES UP

The National Composites Centre (NCC) and Composite Integration have successfully completed a year-long project to design and deliver a state-of-the-art, first of its kind, Large Scale Resin Infusion (LSRI) technology. This innovative system has been designed to meet the R&D demands of both aerospace and wind industry manufacturing where components can range from 17m up to 120m in length.

Liquid Composite Moulding (LCM) is one of the core competencies of the NCC and High-Value manufacturing in the UK. It is used to produce high integrity composite parts, without the need for an autoclave (an industrial pressure cooker). Using Liquid Composite Moulding, fibres are first assembled 'dry' into a mould, resin is then pumped into the fibres and drawn through under vacuum prior to being cured in an oven.

The NCC identified the need to procure a LSRI capability as part of its iCAP Programme, a £36.7m investment in ten digital manufacturing technologies being installed at the NCC to directly stimulate and support

composites innovation, manufacturing and research development programmes across a range of sectors.

The acquisition of the LSRI equipment from South West -based SME, Composite Integration will enable the NCC to widen the applicability of LCM processes to a wider range of components.

The experienced team of NCC engineers, combined with rich process-data from the new equipment, will reduce risk and improve outcomes of high value infusions. The first application of this technology will be to enable infusion of complete wing components as part of next generation wing technology developments.

The new capability, now available to companies across the UK, offers a robust means of LSRI and is capable of injecting high resin volumes into a variety of preforms – primarily, but not limited to, using a vacuum bagged set up.

This modular machine has additional flexibility to process both single or two-part resin systems and will be teamed with a 20m

oven to enable cure of those resins. Together they are expected to create a step change in the production of high quality, high fibre volume fraction composite parts.

The wealth of data collected by the machine is a key component in the NCC driving forwards innovation in technology and techniques to deliver 'Industry 4.0' for composites. The system can already react to this data in real-time to intelligently adapt the infusion parameters and ensure the mould is filled. As the NCC capability develops it will allow for machine learning to recommend infusion cycle improvements based on data acquired from previous infusion cycles.

Peter Giddings, chief engineer, iCAP at the National Composites Centre says: "Our Large Scale Resin Infusion equipment is game-changing for large infusion projects and as part of the iCAP programme takes us significantly closer to achieving our ambition of automating the infusion process to help reduce costs and production cycle times.

"Whether you are manufacturing 18m long composite wings, boat hulls or bridges,






The LSRI machine has allowed us to further develop new state-of-the-art technologies

the equipment and our team of experts is here to help you drive forward your emerging technology to industrial application.”

Simon Vincent, design and engineering manager at composite integration adds: “Processing aerospace grade epoxy resin systems at elevated temperatures brings with it a number of challenges. Although equipment exists on the market for processing smaller quantities of these resin systems, as the scale of Aerospace parts being manufactured using Liquid Resin Infusion has increased, there was an evident need to develop machinery capable of processing up to 400kg of high temperature epoxy resin. This is the first machine of its kind that can process this type of resin in batches larger than 50kg.

“Composite Integration has utilised experience gained through on-going work with the marine and renewable energy markets relating to serial production of ‘large scale’ composite structures as well as research and development carried out on smaller aerospace components to develop a piece of equipment that can accurately monitor and control a wide variety of process variables.

“The LSRI machine has allowed us to further develop new state-of-the-art technologies which, when combined with years of practical processing experience, puts us firmly at the forefront of Out of Autoclave process development.” 

NCC and CFMS join forces

The Centre for Modelling & Simulation (CFMS) has signed a Memorandum of Understanding with the National Composites Centre (NCC) to build a joint digital capability and develop new technologies for the design and rapid manufacture of high-quality composite products.

CFMS, an independent, not-for-profit specialist in digital engineering capability, encourages the exchange of ideas and supports the development of innovative and collaborative practices, as well as provides a digital test bed for the design of high-value engineering products and processes. The NCC, which is located with CFMS at the Bristol & Bath Science Park, is a world leading authority on composites, bringing together the best minds and cutting-edge technology to solve the world’s most complex engineering challenges.

Together, the organisations bring the specialist composite engineering and digital design capabilities needed to accelerate the shift to digital composites manufacturing, in turn speeding up the process from concept to product development at large scales.

With a common interest in identifying disruptive technological advances, the collaboration between CFMS and the NCC will help create a mutual understanding of the strategy and business needs of both organisations, as well as those in the wider engineering and manufacturing industries.

Both organisations will also work together to unlock a series of engineering challenges highlighted in the UK Government’s Made Smarter Review, an industry-led review that sets out how UK manufacturing could maximise productivity through the adoption of industrial digital technology. By combining their strengths, the NCC and CFMS will create a blueprint for the composites industry to deliver Industry 4.0 ambitions.

The two organisations have previously collaborated on projects including Computer Learning in Automated Manufacturing Processes (CLAMPS), which demonstrates the integration of predictive machine learning to drive improvements and minimise variability within a composite manufacturing process. The collaborative project highlights the digitalisation and automation steps necessary to ensure consistently high-quality parts, ultimately reducing costs.

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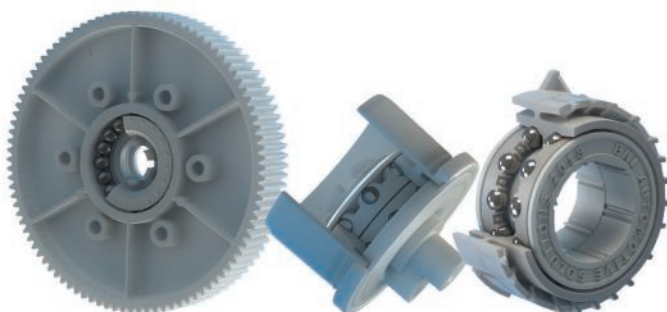
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COMPETENCY-BASED INTERVIEWS

In the UK, it's estimated the engineering and high-tech industries will need 1.8 million new engineers by 2025 which has led to greater demand for skills. However, hiring managers should look beyond these.

With 46% of engineering employers reporting recruitment difficulties in 2017, and with the market expected to tighten even further in 2019, employers should seek to develop the recruitment process and enhance hiring decision making. A 'bad hire' at mid-manager level could end up costing organisations more than £132,000.

Competency-based assessment is not commonly used in the engineering and technology sector for selection purposes, however, it's one of the most effective tools that can be applied during the candidate screening process to predict performance enablers and help an organisation manage talent and articulate a unified, scientifically valid understanding of a high potential talent pool.

A competency-based interview places an emphasis on an engineer's past situational or behavioural experience. Suppose you are trying to judge if an engineer has potential leadership skills, especially if the engineer can eloquently express their skills in this area. As a hiring manager, you should ask questions like: "Tell me about a time where you were faced with ensuring your team completed multiple project deadlines. What did you do and how did it turn out?" or "Tell me when you had to manage or resolve a conflict between two or more co-workers. How serious was the conflict?" or "Tell me about a project you feel you planned for

your team successfully. What made it a success?"


The benefits of adding a competency-based assessment during the interview process range from eliminating bias in the hiring process to decreased employee turnover rates. Competency based recruitment and selection systems often empower hiring managers with additional information to make smarter hiring decisions. The selection process concentrates on the commitment to bringing clarity in selection and recruitment procedures. The competency-based approach negates gut feelings from any party involved in the recruitment or interview process as the selection procedure is governed by objective analysis.

Every high-tech employer seeks engineering talent whose expertise lies in their chosen technical discipline, but other skills and competencies can be just as important, such as communication, organisational and interpersonal skills, innovative thinking, problem-solving etc. A potential engineering candidate must be able to draw upon real situations and examples to highlight those skills. For example, communication may be critical to work with internationally based research and development teams or to work between cross-functional teams.

"Often technical orientated decision makers focus entirely on technical tests and related



criteria when making a hiring decision," says Adam Walker, director at Redline Group (pictured below). "How much time and resources could an organisation save if they knew ahead of time that the candidates weren't the right fit? Or how much more investment could be made in an individual via training, technical development, etc. who today may not have all the technical skills but has the competencies to grow within an organisation."

Redline Group has published a research document entitled 'Competency Based Interviews for Engineers' which is available to read at www.redlinegroup.com. 



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AVOIDING A SOGGY BOTTOM



One of the great things about Britain is the weather. It's a constant source of small-talk because it's always changing.

However, it's not so great on your precious lunch (or coffee) break.

Some of us like a bit of fresh air halfway through the day to get the blood pumping and reinvigorate the grey matter. But in these winter months... well, autumn, spring and most of summer too, come to think of it... dodging the showers can scupper these plans.

Even on a sunny day, a shower may not be far away. Finding a place to sit to have your lunch can be tricky, especially after a downpour, which can leave benches wet for hours afterwards. Either wooden benches soak in the moisture and even when they look dry can still be cold and damp to the touch or, worse still, metal benches can contain puddles of rain water until they are evaporated by the sun.

THE CHALLENGE

This month's challenge then is to come up with a design for public benches that ensures you will be able to keep your bottom dry.

The key to this is thinking about the cost: you're going to potentially be replacing every bench in the country – if not the world – so a low cost, low-tech solution must be a factor. Also, they are outdoor bits of kit, so your design must be



simple enough that it doesn't require major or regular upkeep and maintenance, must be easy to use and must also work all year

round regardless of temperature, humidity or anything else Mother Nature can throw at it. **!**

The idea we have in mind will be revealed in the **April** issue of Eureka! Until then see what you can come up with. Submit your ideas by leaving a comment on the **Coffee Time Challenge** section of the Eureka! website or by emailing the editor: paul.fanning@markallengroup.com

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